



DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

NEW ENGLAND REGIONAL OFFICE
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TECHNICAL
SPECIFICATIONS
FOR THE

RTR ANTENNA
TOWER REPLACEMENT

at the

Standby Remote Transmitter and Receiver Site
Logan International Airport
Boston, MA



PREPARED BY:
BOSTON Communications AJW-E13A
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1-1 SUMMARY OF WORK

1-1.1 General.- These specifications, together with the referenced specifications, and standards specified in the Contract Documents, cover the requirements of the Federal Aviation Administration, hereinafter referred to as the Government or FAA, for certain work associated with the installation of a 10ft high steel antenna tower platform (16ft square), cable ice bridging, underground conduits, counterpoise grounding and lightning protection, removal of old shelter trailer and antenna tower, located at the Boston Logan International Airport Standby Receiver RTR site at Boston, MA.

1-1.2 Scope. – The Contractor shall provide the necessary labor, materials, supplies, and equipment to install: a 16ft square, 10ft high steel antenna tower platform; ice bridging and Heliac coax cables from RTR shelter to the new tower; underground conduits and Sumitomo tube cable and air blown fiber cables from a new fiber splice box outside the 22L Glide Slope building to the new RTR building. Excavate and install concrete footings for antenna tower erect antenna tower along with all associated items: platform, railings, stairs, antenna mounts, grounding and lightning protection, etc.; and perform site work grading as required.

Remove the old 10ft x 20ft x 10ft high RTR trailer shelter (includes asbestos floor tiles) and its concrete pier foundations (to below grade), remove old steel antenna tower (8ft x 25ft x 8ft high) (tower steel is painted with lead paint) and its pier foundations (to below grade). Removal of all asbestos and lead paint shall comply with both OSHA and Mass regulations; with respect to testing, removal and disposal. Remove all cables from the UPS shelter to the existing RTR building. Remove all cables from the existing 22L Glide Slope demark box to the existing RTR building. Remove all empty conduits associated with these cables.

Contractor's work will consist of:

- Site layout, underground cable marking & Identification
- Survey site to identify exact location of new tower w/coordinates (4 corners)
- Soil Boring (1), along with soil data/analysis (**see Appendix - A**)
- Remove existing 2ft x 2ft x 4ft solid concrete block from site location and dispose off-site.
- Excavation, trenching, and backfilling for footing and fiber ductbank.
- Install concrete foundation per tower manufacturer's drawings for the antenna tower structure.
- Supply, assemble and erect the 10ft high antenna tower structure per tower design requirements (**Appendix B**)
- Install a FAA Type: L-810 dual configuration steady burning red LED obstruction light. The obstruction light shall be mounted no less than 12 inches above the uppermost handrail of the tower platform.
- Install 120V, 100W flood light and fixtures by the antenna platform junction box. The flood light will be controlled via 3-way switches located at the flood light and at the base of the antenna tower stair case.
- Supply surveyed latitude and longitude of the middle of the new antenna tower.
- Install self supporting overhead ice bridging/cable tray extended between the new fiberglass RTR shelter to the new antenna platform per drawings.
- Install new coax cable junction box, with ground bars, grounding, and N(F) bulkhead adapters, on the tower platform.
- Install new coax surge protection ground bars, grounding, and Polyphaser coax surge protectors in the new RTR shelter.

- Install 18, ½” Heliac cables (PN: LDF4-50A) from the surge protectors in the new RTR building j-box to the N(F) bulkhead connectors on the tower platform j-box. All Heliac cables shall be terminated with N(M) connectors. The cables shall be connected to a surge protector/ N(F) bulkhead connector.
- Install NEMA 4X junction box to house 1 new tube cable distribution box and 2 fiber optic cable connector patch panels on the 22L Glide slope exterior demarc stand.
- Install 1 new tube distribution box and 1 new fiber cable connector patch panel in the new RTR shelter.
- Install 1 new fiber cable connector patch panel in the 22L GS shelter.
- Install 2, 3” GRS conduits from the new fiber splice box enclosure and terminate within the existing manhole located at the new RTR shelter.
- Install 1, 7-tube cable; 1, 6 MM (62.5 µm) AFB fiber bundle; and 1, 6 SM AFB fiber bundle from the 22L fiber box to the fiber patch panel in the new RTR shelter. Tube cables and AFB fiber bundles shall be installed in one of the new 3” GRSC conduits.
- Install 1, 4-tube cable; 1, 6 MM (62.5 µm); and 1, 6 SM AFB fiber bundle from the 22L fiber box demarc to a new fiber patch panel in the 22L GS shelter.
- Install 2, 3” GRS conduits from MH LV-38A to the new 22L GS fiber demarc box.
- Re-route existing fiber cables from existing old RTR shelter (1 at a time, with delay in between, 4 cables total) to the new 22L GS fiber box. The fiber cables shall be routed one at a time and put into service before the next one is re-routed. The cables are operational and extreme caution shall be used during each cable pull. All cables shall be terminated with ST connectors per contract specs and connected to connector panel as shown on the contract drawings.
- Terminate all fiber cables in the 22L GS fiber box with ST connectors.
- Terminate all fiber bundles in the new fiber patch panel in the new RTR shelter, with ST connectors.
- Terminate all fibers in the new fiber patch panel in the 22L GS with ST connectors.
- Install the specified underground counterpoise grounding and lightning protection system for the tower and connect via exothermic cad-welds to existing RTR shelter counterpoise.
- Install dense graded stone completely under and around the perimeter (extend 3ft beyond tower) of the new tower, and between the tower and new RTR shelter as indicated on drawings.
- Remove old 10ft x 20ft x 10ft high trailer shelter building (contains asbestos floor tiles), along with foundation removal to below grade.
- Remove old steel RTR antenna tower (8ft x 25ft x 8ft high) (painted with lead paint), along with foundation removal to below grade.
- Remove all cables and buried conduits that run between the existing E/G shelter and RTR shelter.
- Remove all cables and buried conduits that run between the existing 22L GS demarc box and the RTR shelter.
- Disconnect existing ground cables that connect the counterpoise to the existing RTR shelter and antenna tower. The existing building and antenna tower counterpoise may be abandoned in place.
- Grade, level and install new topsoil and grass seeding as needed to bring any and all disturbed areas to original conditions.

Installation Procedure

During the installation, all work shall be coordinated with the on-site Contracting Officer's Technical Representative (COTR). A project schedule with anticipated installation and cutover dates shall be submitted to the on-site COTR.

The Contractor shall locate and mark the existing underground power and communication cables, before performing soil boring and beginning any excavation. The Contractor shall coordinate with the on-site COTR for the exact location of the new foundation, underground conduits, conduit markers, and handholes.

Any shutdown of the utility power service to the RTR facility will be coordinated with the on-site COTR. All facility shutdowns shall be requested by the Contractor 48 hours before the desired shutdown. All facility shutdowns will be coordinated with the on-site COTR.

The existing service feed and telecommunication cables to the RTR and other FAA field equipment are buried underground cables. Extreme care must be taken during the excavation process so these cables are not severed or affected. Any disconnection or separation of these cables will result in an inoperable facility that will have a direct effect on air traffic. The Contractor will be fully responsible for the immediate repair and cost of any severed or damaged cables during this contract administration.

The Contractor is advised that the RTR facility is fully operational and any unscheduled interruptions may cause aircraft accidents and loss of life. The facility shall remain operational throughout the entire contract unless a shutdown is scheduled.

1-1.3 Intent of Specifications. - This specification identifies all labor, materials, supplies and equipment to perform the work required to modernize the facility. All work performed and all materials and equipment used shall be subject to the approval of the COTR. This shall include, but not be limited to, testing, inspection, scheduling, reporting, and submittals.

1.1.4 Contract Documents/Drawings. - These documents form a part of this specification:

Drawing No.	Title
BOS-1107372-G001	COVER SHEET
BOS-1107372-G002	GENERAL NOTES (SHEET 1 OF 2)
BOS-1107372-G003	GENERAL NOTES (SHEET 2 OF 2)
BOS-1107372-C001	FACILITY SITE PLAN
BOS-1107372-E001	EQUIPMENT BUILDING AND ANTENNA TOWER, GROUNDING AND LIGHTNING PLAN
BOS-1107372-E002	SURGE PROTECTION GROUND BAR DETAIL
BOS-1107372-Q001	CABLE INSTALLATION PLAN
BOS-1107372-Q002	TOWER PLATFORM JUNCTION BOX AND GROUND BAR DETAILS
BOS-1107372-Q003	22L GLIDE SLOPE FIBER DEMARC BOX AND FIBER PANEL CONNECTION DETAIL
BOS-1107372-Q004	NEW REMOTE RECEIVER SHELTER FIBER DEMARC AND FIBER PANEL CONNECTION DETAIL
BOS-1107372-Q005	22L GLIDE SLOPE SHELTER FIBER DEMARC AND FIBER PANEL CONNECTION DETAIL

1-1.4.1 Measurements: - All dimensions shall be verified, by the contractor, using actual on-site field measurements. Any discrepancies between the specifications/drawings and the existing field conditions shall be referred to the COTR before any work is performed.

1-1.5 Document sources.

1-1.5.1 Federal specifications. - The Federal specifications, standards, supplements, amendments, and indices are prepared and issued by the General Services Administration of the Federal Government. They may be obtained from the Specifications Activity, Printed Materials Supply Division, Building 197, Naval Weapons Plant, Washington, D. C. 20407.

1-1.5.2 Applicable documents. - The current issues of the following documents that are in effect on the date of issuance of the request for offer form a part of this specification and are applicable herein.

- | | | |
|----|------|---|
| 1. | AIA | American Institute of Architects |
| 2. | AISC | American Institute of Steel Construction |
| 3. | ANSI | American National Standards Institute |
| 4. | ACI | American Concrete Institute |
| 5. | FS | Federal Specification |
| 6. | OSHA | Occupational Safety and Health Administration |
| 7. | ASTM | American Society for Testing and Materials |
| 8. | NFPA | National Fire Protection Association |

1-1.5.3 Project Coordination - The Contractor shall be required to coordinate his construction activities with the FAA, MASSPORT, and the System Management Office (SMO) personnel through the RE. All work which effects FAA or flight operations shall be coordinated and approved by FAA personnel through the RE at least twenty-four (24) hours in advance of the scheduled work. Failure to notify and obtain the necessary approval may result in a rescheduling of the work. No claim for delay will be entertained in such case. If weather conditions or aircraft operations preclude a scheduled shutdown of an existing FAA facility or runway, the Contractor shall reschedule the work. The Contractor will be required to coordinate all power shutdowns of existing facilities with the FAA SSC office through the RE at least twenty-four (24) hours in advance.

1-1.5.4 Layout of Work - The Contractor shall lay out his/her work from the established base lines and benchmarks indicated on the drawings and shall be responsible for all measurements in connection therewith. The Contractor shall furnish, at his own expense, all stakes, templates, tools, and materials and labor as may be required in laying out any part of the work. The Contractor will be held responsible for the execution of the work to such lines and grades as may be established or indicated by the RE. It shall be the responsibility of the Contractor to maintain and preserve all stakes and other marks previously established until authorized to remove them. If such marks are destroyed by the Contractor, or through his negligence, before authorized removal, they may be replaced by the RE at his discretion. The expense of replacement will be deducted from any amounts due or to become due to the Contractor.

1-2 SITE ACCESS, CONSTRUCTION LIMITS, USE OF FACILITIES AND WORK HOURS

1-2.1 General.- Contractor shall be escorted at all times by FAA personnel. Access into the site is via Massport Security gates and requires a driver who is fully badged and certified to have access to and be allowed to drive on Logan Airport. Arrangements will be made with the COTR for daily access into the actual RTR site.

1-2.1.2 Damage to site.- Damage to the FAA site or any abutting properties caused by the contractor's activities must be repaired by the contractor. All costs of repairs shall be paid by the contractor. After notice to proceed and prior to the commencement of construction, the contractor and the COTR shall conduct joint inspections of the existing areas to be affected by the construction. Existing conditions shall be noted by both the contractor and the COTR and will be used as the basis for determination of damages caused by the contractor's operations.

1-2.1.3 Contractor's use of premises.-

1-2.1.3.1 Work Hours. - Work shall begin no earlier than 7:00 A.M. each morning Monday through Friday and shall end at 3:30 P.M. Any deviation from this work schedule shall be submitted to the COTR for approval. All work beyond normal work hours shall be requested in writing to the COTR 24 hours in advance. Approval of the request shall be allowed at the COTR's discretion.

During construction, if the contractor plans to stop work, the contractor shall notify the COTR at least 24 hours prior to that time. The contractor shall notify the COTR 48 hours in advance in order to reschedule any on site activity after stopping work.

1-2.1.3.2 Airport Safety. - The Contractor shall comply with all MASSPORT safety requirements for material disposal, badges, radio transceivers, flashing lights, vehicular operations on the AOA, special insurance requirements, displaced threshold markings, and construction safety plans according to OSHA or FAA requirements. MASSPORT has jurisdiction over operating procedures on and around the airport. The Contractor shall comply with the items discussed at the preconstruction conference.

1-2.1.3.3 Airport Security. - The Contractor shall meet all of the security requirements identified by MASSPORT. These requirements will be discussed further at the Preconstruction Conference.

1-2.1.3.4 Equipment Operation. - No equipment will be permitted to extend above the 20:1 obstruction clearance plane along the extended centerline of the runway when landing operations are conducted on the runway. The 20:1 obstruction clearance plane starts at the displaced threshold four hundred (400) feet inboard from the runway threshold (at the runway elevation).

1-2.1.3.5 Work Limitations. - Should increased traffic activity or adverse weather conditions require discontinuance of work that would interfere with air traffic, the Contractor will be required to stop such work promptly and remove any equipment or materials which may constitute interference. Said potential delays shall not result in any additional cost to the government.

1-2.1.3.6 Runway Safety Area Construction Limitations. - No construction materials and/or construction equipment shall be stored within two-hundred fifty (250) feet of the active runway centerline or within one hundred fifty (150) feet of the active taxiway centerline overnight.

No excavation will be allowed to remain open (unprotected) overnight within two hundred fifty (250) feet of the centerline of the runway nor within one hundred fifty (150) feet of the centerline of the taxiway. If the construction activity necessitates that an excavation remain open overnight within this area, the Contractor shall obtain specific written approval from the CO and MASSPORT Operations to utilize steel plates having a minimum thickness of one (1) inch to fully cover the excavation.

Outside the safety zone, over 250 feet from the centerline of the runway and over 150 feet of the centerline of the taxiway, no excavations will be allowed to remain open without the specific written approval of the airport operator and the CO. If approval has been received, the trenches and/or excavations left open overnight shall be marked with warning tape, flashing yellow construction lights, and/or other approved method of marking the construction area.

1-2.1.3.7 Storage Piles. - The location of storage piles shall be as approved by the RE and MASSPORT. Storage piles of any material shall be located so as not to interfere with access to the site.

1-2.1.3.8 Vehicles in Airport Operations Area (AOA). - No movement by the Contractor or his/her subcontractors shall be permitted within the AOA without permission from the RE, MASSPORT and air traffic. All movements within the AOA shall be discussed with the RE. All vehicles operating within the AOA shall be properly identified, and escorted by a radio equipped vehicle with a properly badged driver. AOA operations shall be discussed in detail at the preconstruction meeting.

1-2.1.3.9 Radio Communications. - Refer to Appendix C, MASSPORT Requirements.

1-2.1.3.10 Man-Hole Access. - Access to man-holes shall be coordinated with the RE, MASSPORT Operations, and MASSPORT Fire/ Crash/ Rescue. The Contractor shall follow all MASSPORT requirements for access to and work performed within man-holes. Work in the man-holes shall conform to all OSHA, MASSPORT, FAA, and local regulations.

1-2.1.3.11 Existing Utilities. - Subsurface utilities and cables, whose existence is known to the FAA, are shown on the contract drawings in approximate locations. Other utilities may not be shown on the contract drawings. The Contractor shall field verify the location of underground utilities before excavating. This shall be accomplished, in part, by coordinating with the local FAA System Support Center (SSC), the RE, and Massport Operations.

1-2.1.3.12 Excavation. - Hand excavation methods shall be used in locating all existing utilities. The Contractor at no additional cost to the Government shall immediately repair any damage caused by the Contractor. Repairs, if necessary, shall be in accordance with the specifications and conditions stipulated by the RE.

1-2.1.3.13 MassPort Contractor Requirements - MassPort requires the contractor to supply approved badged escorts. A minimum of two escorts with a Red Badge shall be on site at all times.

1-2.1.3.14 - Contractor shall assume full responsibility for the protection and safekeeping of products stored on the site.

1-2.1.3.15 - The contractor and subcontractors shall maintain the job site in a neat and orderly condition. This includes the daily removal of rubbish, waste materials, tools, equipment, and any other debris that the COTR deems necessary.

1-3 COORDINATION, LOCAL PERMITS AND TESTING

1-3.1 General.-

1-3.1.1 Scope.- This section covers the requirements for testing and permits, inspections and approvals and coordination of construction required to complete the work.

1-3.2 Applicable Documents.- (not used).

1-3.3 Requirements.-

1-3.3.1 Project Coordination.- The contractor shall prepare a detailed schedule of work, and arrange the work so as to prevent conflicts between subcontractors. The contractor shall be responsible for coordination of the work by different trades, and all of the work of this contract. The contractor shall resolve all coordination conflicts that arise among subcontractors.

1-3.3.2 Local permits.- The contractor shall apply, pay fees, and obtain local building permits and inspections as required by the city or state. Permits shall be posted as required.

1-3.3.3 Building Codes.- Construction shall be performed in compliance with the most current editions of BOCA, UBC Building Codes, the National Electrical Code and the specifications mentioned in this document. If Contract Documents exceed code requirements, the Contract Documents shall govern.

1-3.3.4 Test and inspections.- During the progress of work make all tests for the installation required by these specifications. If applicable, perform all testing required by State or local authorities having jurisdiction of the work. Tests shall be made before systems are concealed or covered. Tests shall be made in the presence of the COTR and other authorities requiring tests. Unless specified otherwise, the Contractor shall pay all costs, inspection charges, and fees required for testing the work or materials.

1-3.4 Existing Utilities.- During the progress of the work, the contractor shall provide for all existing utilities and services affected. Maintain existing outlets, switches and lighting, whether or not they are shown on the plans. Continue the existence of all impacted electrical and other services in the building as part of the finished product.

1-4 GOVERNMENT FURNISHED MATERIAL

1-4.4 GFM LIST. - There are no Government Furnished Materials for this project. The contractor shall provide all materials and hardware which are necessary to complete the installation shown on these drawings and as stated within the specifications.

1-4.5 Storage Location.- The contractor shall coordinate with MassPort Operations for permission to use the North Camp site as a staging area.

1-5 PLANNED CONTRACT PROGRESS SCHEDULE

1-5.1 SCHEDULE.- The contractor shall, within 7 days from date of award of contract (unless a different time is specified in the contract), submit to the CO for approval a realistic schedule, showing the order listed below.

1-5.2 Schedule Milestones. -

- Site layout/marketing/identifications
- Surveying of site – layout tower coordinates
- Soil Borings/analysis
- Foundation Design (PE certified)
- Site foundation excavation
- Conduit (duct), splice box, and cable installation
- Foundation installation
- Tower delivery
- Tower erection
- Ice Bridging delivery/installation
- Grounding and lightning protection
- Old RTR shelter removal (with asbestos floor)
- Old RTR antenna platform removal (with lead paint)
- Site grading and repair

1-6 PRECONSTRUCTION CONFERENCE - The contractor shall attend a preconstruction conference to be conducted by the FAA. Local procedures related to ingress-egress, use of premises, station security, construction work schedule, temporary facilities, material disposal, and the FAA SSC (Service Support Center) operations will be discussed. The time and location for the preconstruction conference shall be established by the CO after contract award.

1-7 SUBMITTALS

1-7.1 General.-

1-7.1.1 Submittal requirements.- Provide submittals where required in the individual specification sections and as required below.

1-7.1.2 Prior to the Notice to Proceed.- Specific submittal data currently listed and required by the various sections of this specification shall be submitted to the COTR for approval. The following submittal items must be approved by the FAA prior to the Notice to Proceed:

- Construction Schedule
- Contractor's preconstruction safety and health checklist
- Soil boring analysis data
- Tower fabrication, design, layout (including foundation design- requires MA PE stamped drawings).
- Stand alone/self supporting junction box design for fiber cables / layout / J-box supplied / etc.

- Ice Bridging product information and installation specs
- Written certification that no Asbestos Containing Material will be provided and installed by the contractor

1-7.1.3 Procedure.- Two (2) complete sets of all product data shall be submitted and one set will be marked and returned to the contractor. Each product sheet, submitted for approval, shall have in the lower right hand corner, just above the title block, a 4 inch by 4 inch open space in which the COTR can indicate action taken. All submittals shall be accompanied by transmittal letters identifying the contents of the copy. Submittals shall be delivered in adequate time for FAA review (7 calendar days maximum) and FAA resubmittal review (7 calendar days maximum) before the work, which the respective submittal represents, is fabricated or delivered to the site. Work requiring approval shall not be initiated prior to approval of submittal. Submittals shall be checked by the contractor and coordinated with the work of other trades involved before they are submitted for approval. Submittals incompleteness or inadequate description will be justification for disapproval. Submittals shall bear the following information:

- a. Specification page and paragraph number.
- b. Name of project and facility.
- c. Name of contractor and subcontractor or supplier.
- d. Clearly identified contents and location of work.

1-7.1.4.- By submitting product sheets, the contractor thereby represents that he has determined and verified the following:

- a. Space limitations.
- b. Coordination with equipment furnished under other specification sections.
- c. Catalog numbers and similar data.
- d. Compliance with requirements of the work and of the contract documents.
- e. Compatibility with existing facility materials and sizes.

1-7.1.5 Shop drawing approval.- The checking, marking, or approval of the shop drawings and/or product data by the COTR shall not be construed as a complete check, but will indicate only that the general method of construction and detailing is satisfactory. Approval will not relieve the contractor of the responsibility for any error that may exist. The contractor shall be responsible for the dimensions and design of adequate connections, details, and satisfactory service of the item.

1-7.1.5.1 Approved as submitted.- If "approved as submitted" is marked by the COTR, each copy of the shop drawings or product data will be identified as having received such approval by being stamped and dated. After submittal has been approved, no substitution will be permitted without written approval by the COTR.

1-7.1.5.2 Approved as noted.- If "approved as noted" is marked by the COTR, the shop drawings or product data is satisfactory contingent upon contractor acceptance of corrections, notations, or both and, if accepted, does not require resubmittal.

1-7.1.5.3 Not approved.- If "not approved" is checked by the COTR, the shop drawing or submittal data does not meet job requirements and the contractor must resubmit. If shop drawings or submittal data are disapproved, the contractor shall resubmit the corrected material, in the same quantity as specified for the original submittal.

1-7.1.6 Samples.- The Government reserves the right to request samples of any products or materials proposed for use on this project. Specific samples currently listed under various sections of this specification will be required.

1-7.1.7 Resubmittal.- Resubmit all items marked “disapproved” or “resubmit” within 7 calendar days of receipt. Resubmit construction schedule each 14 days after the original approval with actual dates filled in and dates for any additional submittal or re-submittals.

1-8 TEMPORARY FACILITIES

1-8.1 General.- The contractor shall provide and pay for all temporary services and facilities as specified below and as necessary for the proper and expeditious execution of the work. Contractor shall make, or have made all connections to existing services and sources of supply as necessary and/or indicated and pay all charges for it. Contractor shall provide all labor, materials, equipment, and appurtenances necessary for the complete installation, operation, and maintenance of all temporary service systems and facilities. All work under this section shall comply with applicable laws, rules, regulations, codes, ordinances, and orders of all federal, state, and local authorities having jurisdiction for the safety of persons, materials, and property. Contractor shall remove all such temporary installations and connections when no longer necessary for the project work.

1-8.2 Lighting and Power.- Contractor shall be allowed to use the existing power panel located at the new RTR shelter next to the proposed tower site.

1-8.3 Dumpster.- There are no waste disposal units at the project sites. Contractor shall provide a suitable dumpster for construction waste (or remove all trash and debris from the site on a daily basis). Have container emptied with suitable frequency so that trash does not overflow and blow around site and adjacent property. A cover is required and shall be provided on the dumpster in order for the refuse not to blow out. Contractor shall be responsible for the timely, legal disposal of all construction waste. Contractor shall dispose of all removed equipment that is deemed unusable by the FAA. Determination shall be made by the COTR. All construction waste shall be legally disposed of off the airport, by the Contractor.

1-8.4 Toilet Service.- There are no toilet facilities at the project site. Employ a portable toilet contractor to provide one portable toilet on the job site for the duration of the contract. The paper shall be checked daily and the toilet shall be evacuated and recharged twice weekly.

1-9 MATERIALS AND EQUIPMENT

1-9.1 General.- Material and equipment incorporated into the work shall conform to applicable specifications and standards and comply with size, make, type, and quality specified, or as specifically approved in writing by the COTR. Manufactured and fabricated products shall be designed, fabricated, and assembled in accordance with the best engineering and shop practices. Like parts of duplicate units shall be manufactured to standard sizes and gages, and shall be interchangeable. Two or more items of the same kind shall be identical and manufactured by the same manufacturer. Products shall be suitable for service conditions. Equipment capacities, sizes, and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing. Do not use material or equipment for any purpose

other than for which it is designed or specified. Furnish and install products specified, under options and conditions for substitution stated in this section.

1-9.1.2 Transportation and handling.- Products shall be delivered in undamaged condition, in manufacturer's original containers or packing, with identifying labels intact and legible. Shipments shall be inspected to ensure compliance with requirements of contract documents and approved submittals, and that products are properly protected and undamaged immediately on delivery. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packing.

1-9.2 Asbestos Containing Materials (ACM).- The use of ACM for new material on this project is prohibited. Before the Notice to Proceed the contractor shall provide written certification to the Contracting Officer that no ACM will be used in the proposed construction.

1-10 CONTRACT CLOSE OUT

1-10.1 Acceptance of work.- The Contractor shall schedule a final inspection with the COTR. The Contractor shall correct discrepancies noted during the final inspection, clean the premises and notify the COTR that the work is ready for acceptance.

1-11 SAFETY AND HEALTH

1-11.1 Applicable Publications - The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1-11.1.1 Code of Federal Regulations (CFR)

1-11.1.2 - OSHA General Industry Safety and Health Standards (29 CFR 1910), Publication V2206; OSHA Construction Industry Standards (29 CFR 1926). One source of these regulations is OSHA, which includes a combination of both parts 1910 and 1926 as they relate to construction safety and health. It is for sale by the Superintendent of Documents, U.S. Government Printing Office, Washington DC 20402.

1-11.1.3 - **National Emission Standards** for Hazardous Air Pollutants (40 CFR, Part 61)

1-11.1.4 - **Federal Standard** (Fed. Std.)

1-11.1.5 - **Material Safety Data Sheets**, Preparation and the submission of.

1-11.2 Work Covered by this Section - This section is applicable to all work covered by this contract

1-11.3 Definitions of Hazardous Materials - Refer to hazardous and toxic materials/substances included in Subparts H and Z of 29 CFR 1910; and to others as additionally defined in Fed. Std. 313. Those most commonly encountered include asbestos, polychlorinated biphenyl's (PCBs), explosives, and radioactive material, but may include others, such as lead paint, etc.

1-11.3.1 Spray Painting - No spray painting will be allowed within the construction area, without prior approval from COTR.

1-11.3.2 Smoking - No smoking will be allowed within the building. Smoking shall be confined to designated areas outside the building.

1-11.4 Quality Assurance -

1-11.4.1 Safety Discussion during Preconstruction Conference - Representatives of the contractor shall provide the contractor's safety and health programs during the preconstruction conference. All safety and health provisions pertinent to the work shall be discussed with the CO and the COTR at this time. The contractor shall be prepared to discuss, in detail, the measures he/she intends to take in order to control any unsafe or unhealthy conditions associated with the planned work. The contractor's superintendent and his /her safety representative shall attend this meeting.

1-11.4.2 Compliance with Regulations - All work, including the handling of hazardous materials shall comply with applicable state and municipal safety and health requirements. Where there is a conflict between applicable regulations, the most stringent shall apply.

1-11.4.3 Contractor Responsibility - The contractor shall assume full responsibility and liability for compliance with all applicable regulations pertaining to the health and safety of personnel during the execution of the work.

1-11.4.4 Inspections, tests and reports - Not Used.

1-11.4.5 Safety Plan - The contractor shall submit a plan for maintaining a safe working environment for construction workers employed on this project, and for the rest of the personnel working in the building. As a minimum, the plan shall show scheduled inspections of equipment and job conditions to check for potential hazards. The plan shall contain a statement that current OSHA regulations on safety in the construction industry will be followed. The plan shall list the directions by automobile and the telephone number for the nearest hospital emergency room, and police and fire department numbers. The plan will be used by the COTR to insure that the work is accomplished in accordance with accepted safety practices.

The COTR may stop any operation that is in violation of the OSHA standards and fails to comply with the safety plan or accepted safe work practices.

1-11.5 Submittals -

1-11.5.1 Accident Reporting - A copy of each accident report, which the Contractor or subcontractors submit to insurance carriers, shall be forwarded through the COTR to the CO as soon as possible after the accident occurs.

1-11.5.2 Permits - If hazardous materials are disposed of off site, submit copies of permits from applicable Federal, State, or municipal authorities.

1-11.5.3 Material Safety Data Sheets - The material safety data sheets shall be provided for posting on the job site by the COTR on every material the contractor provides including but not limited to construction adhesives, paint, solvents for cleaning and fuel, if applicable. MSDS sheets shall be as printed by the material manufacturer.

1-11.5.4 OSHA Bulletins.- Post the bulletins on construction health and safety as required by law. Post an emergency notice with telephone numbers for medical, Police, Fire, EPA, and Poison Control Center telephone numbers in the stairwell area. Submit this item prior to commencing any work.

1-11.6 Materials and Equipment - Special facilities, devices, equipment, clothing, and similar items used by the contractor in the execution of work shall comply with the applicable regulations.

1-11.7 Hazardous Materials - The contractor shall bring to the attention of the COTR any material suspected of being hazardous which he/she encounters during execution of the work. A determination will be made by the COTR as to whether the contractor shall perform tests, and/or if the material is found hazardous and additional protective measures are needed, a contract change may be required, subject to applicable provisions of the contract.

1-11.8 Suspension of Work - When the contractor or his/her subcontractors are notified by the COTR of any unsafe conditions caused by noncompliance with the provisions of the contract, the contractor shall immediately correct the unsafe or unhealthy condition. If the contractor fails to correct the problem condition(s) to the satisfaction of the COTR promptly, all or any part of the work may be suspended in accordance with AMS Clause No. 3.10.1-8, "Suspension of Work". When, in the opinion of the COTR, satisfactory corrective action has been taken to correct the unsafe and unhealthy condition, a start order will be provided immediately. No extension of time or compensation will be allowed in connection with or by reason of this type of work stoppage.

1-11.9 Protection - The contractor shall take all necessary precautions to prevent injury to the public, building occupants or his/her employees. The contractor shall take all necessary precautions to prevent public or private property damage or loss.

1-11.9.1 - Work shall not be performed in any area occupied by Federal employees unless adequate steps are taken for the protection of Federal employees.

1-11.9.2 -Whenever practicable, the work area shall be fenced, barricaded, or otherwise blocked off to prevent unauthorized entry into the work area. This includes marking off and barricading the perimeter of excavated areas until backfilled.

1-11.9.3 Alternate precautions - When the nature of the work prevents isolation of the work area, alternate precautions such as the posting of signs, the use of signal persons, the erection of barricades or similar protection around particularly hazardous operations shall be used as appropriate.

END OF SECTION 1

2-2 GENERAL SITE WORK

2-2.1 GENERAL - This section covers the requirements of general site work, consisting of excavation, trenching, backfilling, compacting, soil stabilization, grading, graveling, and clean-up.

2-2.1.1 SCOPE - Excavate for the new tower foundation. Perform trenching for the new direct buried conduits as indicated on the contract drawings. Restore grading with approved equipment at the site as directed by the COTR.

2-2.2 APPLICABLE DOCUMENTS - The following publications of the issues in effect on the date of this solicitation form a part of this section to the extent referenced.

American Society for Testing and Materials (ASTM):

D 2922-81 Test Methods for Density of Soil and Soil
Aggregate in Place by Nuclear Methods (Shallow Depth)

Federal Specification FAA-C-1391b (Installation and Splicing of Underground Cables).

2-2.3 MATERIALS -

2-2.3.1 Site Materials - Trench backfill material shall be sand and stone-free earth as specified hereinafter and shall be in accordance with Federal FAA-C-1391b (Installation and Splicing of Underground Cables), no stones larger than 1 inch contained in backfill material.

2-2.3.2 Fill Materials - All fill material shall be free from organic matter, debris, vegetation and other deleterious substances. It shall be of a quality suitable for the purpose intended and shall compact thoroughly without the presence of excessive voids when watered and compacted. Fill shall be non-expansive in nature.

2-2.4 CONSTRUCTION -

2-2.4.3 Excavation - Excavation shall take place only after complete identification of all underground cables and utilities have been properly identified at the site. Any interruption or damage to underground cables or utilities will be repaired immediately to the COTR's satisfaction at the contractors expense. Excavation procedures shall adhere to all OSHA and Safety standards (both Federal and State) with respect to slope, use of trench boxes, excavator set back, etc.

The contractor shall use extreme caution when excavating within 10ft of known underground utilities or cables. Hand digging/excavation will be required in any areas within a proximity of 10ft or less from these known and identified utilities and cables.

2-2.4.4 Trenching - Underground cable and utility trenches shall be excavated where shown on the drawings. Trenches shall be excavated to a depth as indicated on the drawings. All underground cable trenching shall conform to Federal Order FAA-C-1391b (Installation and Splicing of Underground Cables). All trenches shall run as indicated and shall be the depth indicated on the drawings. Cable, conduit, or pipes shall not vary more than four (4) inches either side of the straight line layout.

2-2.4.4.1 Over Excavation - Where excavation is carried to a depth greater than required, backfilling shall be subject to approval by the COTR and shall be compacted as required.

2-2.4.4.2 Wet Excavation - No additional compensation will be allowed for any sheeting, shoring, pumping, or draining required to place and keep excavations in dry condition for construction. No water shall be allowed to remain in or around any part of the work.

2-2.4.4.3 Existing Facilities - Contact local FAA personnel through the COTR prior to the start of any excavation. Maintain a record of phone conversations and site meetings that take place. Additionally, prior to any excavation or trenching, utilize a cable detector to verify and locate any utilities and cable runs which may be in the vicinity of site work or crossed by the new cable runs. **The existing utilities and cable runs shall be exposed by hand digging in these areas and shall be protected from any possible damage.** Any damage caused by the contractor shall be immediately repaired with materials and methods approved by the COTR at no additional cost to the Government.

2-2.4.4.4 Connections to Existing Utilities - Conduit feeds for the communication cables (fiber) are to be installed from the existing RTR shelter to the new RTR building located adjacent to the new tower. This work will be accomplished in two separate phases, with a delay between the two, coordinate with COTR as required.

2-2.4.4.5 Trench Backfill and Fill - Layers shall not exceed loose depths of 8 inches as specified in FAA-C-1391b (Installation and Splicing of Underground Cables). Each layer shall be properly moistened and compacted, as specified herein, by power operated mechanical equipment. Where utilities are not shown to be concrete encased, the first layer of backfill shall be 3 inches sand, with no particles over 1/4 inch diameter.

2-2.4.4.6 Plastic Marking Tape - Plastic marking tape for identifying and locating underground utilities shall be acid and alkali resistant polyethylene film, 6 inches wide and 0.004 inch thick. Tape shall have foil backing to enable detection by metal detector at a depth of 3 feet. All utility lines shall be marked with a printed inscription and color as follows:

Red:	Electric Duct.
Yellow:	Fuel Line.
Orange:	Telephone and Communications.
Blue:	Water Line.
Green:	Sanitary Sewer Line.

2-2.4.5 Aggregate Base - Dense Graded Stone (FAA P-209)max stone $\frac{3}{4}$ " – Mass DOT Spec M2.01.7.

2-2.4.6 Compaction - All loose or disturbed soil shall be compacted in place by approved compaction equipment with a minimum of four complete passes over the entire area.

2-2.4.7 Grading - Grade site areas to the lines and grades indicated on the drawings or as directed. Slope graded areas approximately 2% for drainage away from the structures and site area. Areas within the limit of grading shall be finish graded to fill ruts, holes, etc., and to remove surface rocks or boulders.

2-2.4.8 Pavement Removal - (Not Used)

2-2.4.9 Pavement Replacement - (Not Used)

2-2.4.10 ENVIRONMENTAL CONSIDERATIONS -

2-2.4.10.1 General. - All construction operations shall be conducted in such a manner as to prevent the pollution to air, water or land, and shall, within reasonable limits control noise and the disposal of solid waste material, as well as other pollutants.

2-2.4.10.2 Protection of water resources. - The Contractor shall control the disposal of fuels, oils, bitumens, calcium chloride, acids or harmful materials, both on and off the premises and shall comply with applicable Federal, State, County and Municipal laws concerning pollution of rivers and streams while performing work under this contract. Special measures shall be taken to prevent chemicals, fuels, oils, greases, bituminous materials, herbicides and insecticides, and surface drainage from entering public waters. Water used in on-site material processing, concrete curing, foundation and concrete cleanup, and other waste waters shall not be allowed to re-enter a stream if an increase in the turbidity of the stream could result.

2-2.4.10.3 Dust control. - The Contractor shall maintain all excavations, embankments, stockpiles, access roads, plant sites, waste areas, borrow areas, and all other work areas free from excess dust to such reasonable degree as to avoid causing a hazard or nuisance to the Using Service or to others. Approved temporary methods consisting of sprinkling, chemical treatment, or similar methods will be permitted to control dust. Dust control shall be performed as the work proceeds and whenever a dust nuisance or hazard occurs.

2-2.4.10.4 Erosion control. - Surface drainage from cuts and fills within the construction limits, whether or not completed, and from borrow and waste disposal areas, shall be graded to control erosion within acceptable limits. Temporary control measures shall be provided and maintained until permanent drainage facilities are completed and operative. The area of bare soil exposed at any one time by construction operations should be held to a minimum.

2-2.4.10.5 Post-construction cleanup. - The Contractor shall cleanup and eliminate any and all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, and other vestiges of construction prior to final acceptance of the work. These disturbed areas shall be graded and filled and the areas seeded unless otherwise noted on the drawings.

2-2.5 QUALITY ASSURANCE -

2-2.5.1 - When excavations are completed, the contractor shall notify the COTR for his inspection and approval prior to placement of concrete or installation of cables, ducts, conduits, or piping.

2-3 - NOT APPLICABLE

2-4 EXCAVATING AND BACKFILLING FOR UTILITY SYSTEMS AND TOWER -

2-4.1 GENERAL -

2-4.1.1 Scope - Excavate all soil for the necessary trenches for underground conduits to be installed at the new Remote Transmitter and Receiver facility (RTR). Backfill and compact after the COTR has inspected the work and authorizes it. Purchase and install the specified sand at the bottom of conduit trenches as shown on the drawings. Provide sufficient compaction of soil for installation of aggregate base course and conduit. Purchase and install the specified geo-textile filter fabric and $\frac{3}{4}$ " Dense Graded Stone (P-209 or M2.01.7) for the work of this project. Distribute and or remove the left over material about the site as directed by the COTR.

2-4.1.2 Related Work In Other Sections -

Section 16 Electrical

2-4.2 Applicable Documents - The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

2-4.2.1 American Society For Testing and Materials -

ASTM D698 Standard Test Methods for Moisture Density Relations of Soils and Soil Aggregate Mixtures Using 5.5 lb Rammer and 12-inch Drop

ASTM D1556 Density of Soil in Place by the Sand-Cone Method

ASTM C33 Standard Specification For Concrete Aggregates

2-4.3 MATERIALS -

2-4.3.1 Filter/Separation Fabric - A non-woven fabric, needle punched and heat fused of 100 percent polypropylene staple fiber; permeable to moisture transmittal, minimum 4.5 ounces per square yard and conforming to the following additional criteria:

Grab strength, length direction. lb.= 90

Grab strength, width direction. lb.= 110

Elongation at break, length direction, percentage 65

Elongation at break, width direction, percentage 65

Coefficient of permeability K, c/Sec 5×10^{-2}

2-4.3.2 Sand - Material meeting the requirements and grading criteria for fine aggregate in ASTM C33.

2-4.3.3 Dense Graded Stone – Use MA DOT State Highway specification M2.01.7 for “Dense Graded Crushed Stone” or P-209 “Crushed Aggregate Base Course”, $\frac{3}{4}$ " max size in areas as shown on drawings over filter fabric.

ITEM P-209 CRUSHED AGGREGATE BASE COURSE

DESCRIPTION

209-1.1 This item consists of a base course composed of crushed aggregates constructed on a prepared course in accordance with these specifications and in conformity to the dimensions and typical cross sections shown on the plans.

209-1.2 PLACING. The crushed aggregate base material shall be placed on the moistened subgrade in layers of uniform thickness with a mechanical spreader.

The maximum depth of a compacted layer shall be 6 inches (150 mm). If the total depth of the compacted material is more than 6 inches (150 mm), it shall be constructed in two or more layers. In multi-layer construction, the base course shall be placed in approximately equal-depth layers.

The previously constructed layer should be cleaned of loose and foreign material prior to placing the next layer. The surface of the compacted material shall be kept moist until covered with the next layer.

209-1.3 COMPACTION. Immediately upon completion of the spreading operations, the crushed aggregate shall be thoroughly compacted. The number, type, and weight of rollers shall be sufficient to compact the material to the required density.

The moisture content of the material during placing operations shall not be below, nor more than 2 percentage points above, the optimum moisture content as determined by ASTM [].

209-1.4 FINISHING. The surface of the aggregate base course shall be finished by blading or with automated equipment especially designed for this purpose. In no case will the addition of thin layers of material be added to the top layer of base course to meet grade. If the elevation of the top layer is 1/2 inch (12 mm) or more below grade, the top layer of base shall be scarified to a depth of at least 3 inches (75 mm), new material added, and the layer shall be blended and re-compacted to bring it to grade. If the finished surface is above plan grade, it shall be cut back to grade and rerolled.

209-1.5 SURFACE TOLERANCES. The finished surface shall not vary more than 3/8 inch (9 mm) when tested with a 16-foot (4.8 m) straightedge applied parallel with or at right angles to the centerline. Any deviation in excess of this amount shall be corrected by the Contractor at the Contractor's expense.

209-1.6 THICKNESS CONTROL. The completed thickness of the base course shall be within 1/2 inch (12 mm) of the design thickness

2-4.4 Excavation - Excavation shall be unclassified and include the removal of all materials of every name and nature, including all earth and rock of any type and obstructions of any type, either natural or man made which may be required for the installation of all work described in the various divisions of these specifications.

2-4.4.1 Structures - Excavate to the depths and dimensions indicated for footings, foundations, slabs on grade and other structures. In the event unsuitable or unstable soil is encountered below this limit, the COTR will determine the depth of removal of such soil. Cut sides and bottom of foundation excavations clean. In all instances, allow sufficient room for installation and inspection of forms.

2-4.4.2 Access Road and Parking Area – N/A

2-4.4.3 Unauthorized excavation and low areas - Where the contractor excavates beyond the lines shown on the drawings, the contractor at no additional cost to the Government, shall fill to the indicated sub-grades as follows:

2-4.4.3.1 Footings and Foundations - Where soil bearing footings and foundations for the new structures will occur, the fill shall be of the same proportions as specified for footings and foundations; the quality shall also be the same, all as described in division 3 of this specification.

2-4.4.3.2 Slab – N/A.

2-4.5 FILLING AND BACKFILLING -

2-4.5.1 General - Unless otherwise specified, place all fills and backfills in layers compatible with compaction requirements, but not in layers exceeding six inches for the entire width so that each layer can be uniformly and properly compacted.

2-4.5.2 Borrow - Excavated material from the site that is suitable as approved by the COTR, may be used for filling or backfilling. Procure any additional material as necessary for site fill from approved borrow pits.

2-4.6 COMPACTION REQUIREMENTS -

2-4.6.1 Filling and backfilling under slabs and structures. - Place fill and backfill under slabs and structures and the backfill against structures in equal layers as specified herein before and compact each layer under slabs and structures to 95 percent maximum density at optimum moisture in accordance with ASTM D-698.

2-4.6.2 Subgrade compaction - Subgrade under all crushed stone areas and the door step slab shall be compacted to 95 percent of maximum density at optimum moisture in accordance with ASTM D698, for a minimum depth of 12 inches.

2-4.6.3 Trench compaction and fill in other areas - All fill in utility trenches and other areas shall be placed in not over 6-inch layers and compacted to 90 percent maximum density at optimum moisture in accordance with ASTM D698.

2-4.6.4 DENSE GRADED STONE UNDER AND AROUND BUILDINGS

2-4.6.4.1 Type – Dense Graded stone shall be P-209 or MA DOT M2.01.7 Specification for “Dense Graded Crushed Stone for Sub-base” equal, free from adherent coatings, and shall contain no soft, thin or elongated pieces, dirt, or organic material. Material shall be secured from an acceptable source off-site.

2-4.6.4.2 Size – Maximum large aggregate stone size shall be $\frac{3}{4}$ ”.

2-4.6.4.3 Application - The dense graded stone material shall be spread evenly over the prepared subgrade, backfill, or filtration/separation media so that after rolling and compacting, the thickness of the course shall be as indicated on the drawings. Maintain the grade of the material during spreading and compaction so that no segregation of sized occurs and no pockets of fine material are formed.

2-4.6.4.4 Compaction - The dense graded stone course shall be compacted in place by approved compaction equipment and with a minimum of eight complete passes over the entire area and meeting 95 percent of the maximum dry density at optimum moisture in accordance with ASTM D-698.

2-4.7 QUALITY ASSURANCE -

2-4.7.1 General - The Contractor shall establish and maintain quality control for operations under this section to assure compliance with contract requirements and maintain records of his quality control for all materials, equipment and construction operations.

2-4.7.2 Testing – (Not Used)

END OF SECTION 2

3-1 CONCRETE FORMWORK -

3-1.1 General -

3-1.1.1 Work included.- Unless they are specified elsewhere, provide forms and related work required for cast-in-place concrete, including the following:

Structural concrete:

1. Tower foundation

3-1.1.2 Related work in other sections.-

Section 2-4 Excavations for concrete footing

3-1.2 Applicable documents.- The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

3-1.2.1 American Concrete Institute (ACI) Publications.-

- 301 Specifications for Structural Concrete for Buildings, Chapters 1, 4, 18
- 318 Building Code Requirements of Reinforced Concrete
- 347 Recommended Practice for Concrete Formwork Chapters 1, 2
- SP4 Formwork for Concrete, Chapters 6, 7

3-1.2.2 American Society for Testing and Materials (ASTM).-

- A307 Low Carbon Steel Externally and Internally Threaded Standard Fasteners.
- D1752 Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

3-1.2.3 U.S. Department of Commerce, National Bureau of Standards.-

- PS1-66 Softwood Plywood - Construction and Industrial

3-1.3 Materials.-

3-1.3.1 Form framing.- Southern Yellow Pine or Douglas Fir construction grade or better, dressed or rough.

3-1.3.2 Form sheathing.-

3-1.3.2.1 Boards.- Southern Yellow Pine or Douglas Fir construction grade or better, S4S 1 x 6 boards. Use center matched boards where forms are unlined and concrete will be visible.

3-1.3.2.2 Plywood.- Plywood shall comply with U.S. Product Standard PS1-66 and bear grade trademark of the American Plywood Association. B-B Plyform Class 1 exterior, 5/8 inch thick minimum.

3-1.3.3 Accessories.- Spreaders, etc., of required type, size and finish.

3-1.3.4 Form coating.- Non-staining chemical compound compatible with the direct applied coating required on concrete. Submit brand for approval.

3-1.3.5 Anchor bolts and plates.- Carbon steel: ASTM A307 Grade B, galvanized.

3-1.3.6 Compressible filler.- Cork, ASTM D1752, Type II

3-1.4 Installation.-

3-1.4.1 Relation with other trades.- Inserts, anchors, sleeves, bolts, plates, and similar items required by other trades to be cast in concrete work shall be furnished and located by each such trade. Build such items into forms in a manner that will prevent displacement or damage to them during placing of concrete. Verify sizes and locations. Contractor shall be responsible for inspecting all construction documents to ensure the proper installation of all embedded items and provisions of openings. Provide pads required for exterior equipment as shown.

3-1.4.2 Forms for structural concrete.-

3-1.4.2.1 Tolerances.-

3-1.4.2.1.1 General.- Unless otherwise specified, shown, or required to accommodate abutting or adjacent materials, conform to ACI 301 Table 4.3.1 which shall be considered maximum and shall be reduced as necessary to conform to details and to permit the proper installation of adjacent and abutting materials.

3-1.4.2.1.2 Correction.- Correct work outside of required tolerances as directed without limit to extent of work required.

3-1.4.2.2 Support of forms.- The total responsibility for the proper and adequate design, construction, support and bracing of forms to provide the required concrete sections and to support, without deflection, the wet concrete and other construction loads imposed on them rests entirely with the contractor. The requirements of this Specification are to be considered as minimum only. Rebrace, tighten, etc., any displaced forms as necessary to bring them back to required line and level.

3-1.4.3 Unlined wood forms.- Contact surface shall be free of warpage, cupping and large or loose knots. Break joints and double nail.

3-1.4.4 Slabs.- N/A

3-1.4.5 Ties and spreaders.- Lengths shall be as required to provide proper concrete thickness. When practical, locate and space ties and spreaders symmetrically at approximately 3 foot centers both ways, in plumb tiers and level rows.

3-1.4.6 Expansion joints.- N/A.

3-1.4.7 Construction joint.-

3-1.4.7.1 Vertical joints.- N/A

3-1.4.8 Form coating.- Coat the inside of forms in accordance with coating manufacturer's printed installation instructions.

3-1.4.9 Checking forms.- As concrete is placed, make frequent checks on forms to detect any change in position. Replace, tighten, etc., any displaced forms as necessary to bring them back to required line and level.

3-1.4.10 Equipment pads.- (Not Used)

3-1.5 Quality assurance.-

3-1.5.1 Construction of forms.- Locate and construct forms accurately so that finished concrete will conform to shapes, lines, grades and dimensions shown on the drawings. Joints shall be vertical unless otherwise specified, and sufficiently tight to prevent leakage.

3-1.5.2 Size of forms.- Size forms so that all reinforcing, ties, etc., shall have the minimum coverage required in the structural general notes on the drawings. Thickness of concrete coverage shall be measured from face of vertical or horizontal bars and face of stirrups in beams. Coverage not indicated shall conform to ACI 318.

3-2 CONCRETE REINFORCEMENT

3-2.1 General.-

3-2.1.1 Work included.- Fabricate and install reinforcing and the related accessories required for cast-in-place concrete work not specified elsewhere including the following work:

one - 10 foot self supporting steel tower foundation

3-2.1.2 Related work in other sections.- N/A

3-2.2 Applicable documents.- The following specifications and standards of the issues currently in force form a part of this section.

3-2.2.1 Federal Specifications.-

QQ-W-461 Wire, Steel, Carbon (Round, Bare and Coated)

3-2.2.2 American Society for Testing and Materials (ASTM) Publications.-

A185 Welded Steel Wire Fabric for Concrete

3-2.2.3 American Concrete Institute (ACI).-

318 Building Code Requirements for Reinforced Concrete

3-2.2.4 Concrete Reinforcing Steel Institute (CRSI).-

Manual of Standard Practice and Recommended Practice for Placing Reinforcing Bars

3-2.3 Materials.-

3-2.3.1 General.- All of the following materials shall be produced and fabricated in the U.S.A.

3-2.3.2 Reinforcing steel.- Carrying rolled-on identifying marks to denote the mill location, bar size and type of steel. Grade 40 shall also be marked to indicate minimum yield.

3-2.3.2.1 Deformed billet steel.- ASTM A615 of the grades shown on the drawings and specified.

3-2.3.3 Welded wire fabric.- ASTM A185 cold drawn steel wire welded fabric. See Structural Drawings for size of wires and mesh size.

3-2.3.4 Dowels.- Conform to Paragraph 3-2.3.2

3-2.3.5 Stirrups and ties.- Conform to Paragraph 3-2.3.2

3-2.3.6 Accessories.- Provide spacers, chairs, wire ties, etc., necessary to properly assemble, space and support the reinforcing in place during placement of concrete, as recommended by the Concrete Reinforcing Steel Institute. Accessories shall be sized to provide required concrete coverage. Position and support bolts, anchors, and other cast-in items with appropriate accessories. Spacers, chairs, wire ties, etc., fabricated of standard bright basic wire. Chairs placed on porous fill shall have 3 x 3 inch 16 gage steel base pads or plates to prevent them from penetrating the supporting surface.

3-2.3.7 Tie wire.-

3-2.3.7.1 For reinforcing steel.- Federal Specification QQ-W-461, 16 gage minimum annealed black steel.

3-2.4 Installation.-

3-2.4.1 Extent of work.- Provide reinforcing for all concrete unless it is definitely specified or noted to be plain or unreinforced.

3-2.4.2 Marking.- Use standard waterproof tags. All designations shall coordinate with the Structural Drawings.

3-2.4.3 Tolerance.- The following are maximum allowable tolerances:

3.2.4.3.1 Fabrication.-

Sheared length: Plus or minus 1 inch.
Depth of truss bars: Plus 0 or minus 1/2 inch.
Stirrups, ties: Plus or minus 1/2 inch.
All other bends: Plus or minus 1 inch.

3-2.4.3.2 Placement.-

Concrete cover to form surfaces: Plus or minus 1/4 inch.
Minimum spacing between bars: 1/4 inch.
Top bars in slabs: Minimum 2' cover.
Members 8 inches or less deep: Plus or minus 1/4 inch.
Crosswise of members: Space evenly within 2 inches of stated separation.
Lengthwise of members: Plus or minus 2 inches.
Maximum bar movement to avoid interference with other reinforcing steel, conduit or other embedded work: 1 bar diameter.

3-2.4.4 Fabrication of reinforcing bars.-

3-2.4.4.1 Material.- Use deformed bars unless otherwise specified or shown.

3-2.4.4.2 Forming.- Unless noted otherwise, bend bars cold. Do not straighten or rebend without specific approval from COTR. Torch cutting at the job will not be permitted without prior approval of the COTR.

3-2.4.4.3 Joints.- Construction joints - Continue reinforcing through joint.

3-2.4.4.4 Laps and splices.- Use a minimum number of splices. Lap splices in strict accord with ACI 318 or as shown. Do not make splices at points of maximum stress. Stagger splices in adjacent bars.

3-2.4.5 Cleaning.- Remove from reinforcing scale, heavy rust, and any coating which would reduce bond.

3-2.4.6 Placement.-

3-2.4.6.1 Slabs.-N/A

3-2.4.6.1.1 Grade supported slabs.- Support reinforcing on sheet metal chairs spaced 4 feet apart.

3-2.4.6.1.2 Welded wire fabric.- N/A

3-2.4.6.2 Anchor bolts.- If reinforcing conflicts with location of anchor bolts, inserts, etc., required to be cased in concrete, submit prompt notifications so that revisions can be made before concrete is placed. No cutting of reinforcing will be permitted without prior approval from the COTR.

3-2.5 Quality assurance.-

3-2.5.1 Submittals.- Conform to procedures specified and the requirements below.

3-2.5.1.1 Shop drawings.- Show sizes and dimensions for fabrication and placing reinforcing steel and bar supports. Include bar schedules, and diagrams of bent bars. Indicate marking system used to identify types of steel required.

3-2.5.1.2 Mill reports.- Submit manufacturer's certified mill test sheets giving properties of steel used to fabricate reinforcing and location of mill.

3-2.5.2 Testing.- If testing is ordered, furnish required test specimens and cooperate with the testing laboratory.

3-2.5.3 Storage.- Store reinforcing so that it is not less than 6 inches above ground.

3-3 CAST-IN-PLACE CONCRETE

3-3.1 General.

3-3.1.1 Work included.- Provide cast-in-place concrete including concrete required for the following work:

1– 10 foot tower foundation

3-3.1.2 Related work in other sections.

Testing: General Conditions

3-3.2 Applicable documents.- The following specifications and standards of the issues currently in force form a part of this section and are applicable as specified herein.

3-3.2.1 American Society for Testing and Materials (ASTM) Publications.

C33	Concrete Aggregates
C94	Ready-Mixed Concrete
C150	Portland Cement
C260	Air-Entraining Admixtures for Concrete
C494	Chemical Admixtures for Concrete
C618	Fly Ash and Raw or Calcinated Natural Pozolan for Use as a Mineral Admixture in Portland Cement Concrete

3-3.2.2 American Concrete Institute (ACI).

318 Building code requirements for reinforced concrete, all chapters.

3-3.2.3 U.S. Department of Commerce Commercial Standards (CS).

CS-238 Polyethylene Sheet

3-3.3 Materials.

3-3.3.1 Cement.- ASTM C150, Type I Grey Portland Cement. The use of Type III permitted only with specific approval. Submit brand name and mill reports for approval. Use only approved brand for all concrete.

3-3.3.2 Stone aggregate.- Conforming to ASTM C33. Fine - Natural sand. Coarse - Gravel or crushed stone, 1-1/2 inch maximum.

3-3.3.3 Water.- Potable.

3-3.3.4 Chemical admix.- ASTM C494 Type A or D (Type E may be used in cold weather upon written approval) polymer type compound (lignon compounds not acceptable) in liquid form, manufactured by one of the following firms:

Gifford-Hill and Co., Inc.
W.R. Grace and Co.
Master Builders
Sika Chemical Corporation
Or other approved manufacturer.

Submit name of manufacturer or product proposed for use, as determined by weather conditions during time of concrete placement, as well as recommended quantity.

3-3.3.5 Air entraining admix.- ASTM C260 liquid vinsol resin compound compatible with chemical admix used.

Master Builders - MB-VR Protect Industries, Inc.
Protex Air Entraining Solution
Sika Chemical Corporation - Sika AER
Or approved equal.

3-3.3.6 Vapor barrier.- Six-mil clear polyethylene sheeting, CS-238.

3-3.3.7 Fly ash.- ASTM C618, Class C or Class F, loss on ignition shall not exceed 1%. Submit source and test reports for approval.

3-3.3.8 Perimeter insulation.- Waterproof type similar to Styrofoam, SM as manufactured by Dow Chemical Company, or approved equal.

3-3.4 Installation.-

3-3.4.1 Relation with other trades.- Check other trades prior to placing concrete to ascertain that their work is in place. Where other work is required to be applied to concrete, provide satisfactory surface to receive it.

3-3.4.2 Cast-in anchors and accessories.- Carefully place items required to be cast into concrete at location set by trade which furnishes them.

3-3.4.3 Testing.- Provide material and cooperate with testing laboratory. The contractor shall take two 6" dia by 12" concrete sample cylinders from each truck, for 7 and 28 day testing. The samples shall be taken in accordance ASTM-C 172-71. (Cost of testing to be paid by the contractor). Reports shall be submitted to the COTR.

3-3.4.4 Retempering.- Concrete that is partially hardened shall not be retempered.

3-3.4.5 Strength tests.- Conform to the requirements of ASTM C94.

3-3.4.6 Strength requirements. Per tower manufacturers foundation design calcs

3-3.4.6.1 Minimum compressive strength.- 3000 psi at 28 days (or as required per tower manufacturers design)

3-3.4.6.2 Structural stone concrete.- Provide strength and type required on Structural Drawings.

3-3.4.7 Structural concrete - proportioning.-

3-3.4.7.1 General.- Conform to ACI 301 Standards. The mix design is intended to produce concrete which, when cured, will have a 28-day compressive strength equal to or greater than that required. If the strength required for the class of concrete being produced is not secured with the minimum cement content, additional cement shall be used or other aggregate provided at the contractor's expense.

3-3.4.7.2 Proportioning of ingredients.- Determine mix proportions in conformance with Standards using Method 1 or 2. Prior to commencing operations, submit a statement indicating the mix proportions of the ingredients, maximum nominal coarse-aggregate size and slump of the mix that will be used. Proportions shall indicate weights of aggregates in saturated surface-dry condition. Accompany the statement with satisfactory evidence attesting that the proportions furnished will produce concrete of the quality indicated. Submit design for strength of concrete to be used in time to conduct strength tests as specified in paragraph 3-3.4.5 and to redesign and retest if necessary before any concrete is ordered.

3-3.4.7.3 Chemical admix.- Quantity, preparation and mixing shall conform to admix manufacturer's directions for use at temperatures anticipated when concrete will be placed.

3-3.4.7.3.1 Requirement.- Admix may be used at the contractor's option. If used, adjust formulas for concrete mix to provide for it and obtain approval before concrete is ordered.

3-3.4.7.4 Air-entraining admix - required in concrete.- Conform to admixture manufacturer's directions for quantity, preparation and mixing.

3-3.4.7.5 Mixing.- Concrete shall be procured from an approved "ready-mixed" concrete plant as follows: Transit or ready-mixed concrete and delivery operations - Conform to ASTM C94. Do not add water at the job unless prior approval by COTR is given. Record the amount of any added water on each copy of the Delivery Ticket. If water is added, mix batch an additional 1 minute per yard of concrete, at slow speed, before placing it. Use no concrete which has been held in a mixer truck longer than 1-1/2 hours.

3-3.4.8 Structural concrete - placement.-

3-3.4.8.1 Preliminary work.-

3-3.4.8.1.1 General.- Verify that forms are clean and coated, and that reinforcing, pipes, conduit, sleeves, anchors, and other work required to be cast in concrete have been properly installed. Such work must be inspected and approved before placing is begun.

3-3.4.8.1.2 Concrete on grade or fill.- Wet subsurface prior to placing concrete on it unless a membrane or sheeting has been installed to cover it.

3-3.4.8.2 Temperatures.- Do not place concrete unless temperature is at least 40 degrees F. and rising. For temperatures below 40 degrees F., special approved methods will be required.

3-3.4.8.3 Method.- Place concrete in the forms as rapidly as practical by methods that will prevent loss or separation of the ingredients. Deposit it as nearly as practicable in its final position in such a manner as to maintain a plastic surface which is approximately horizontal. If necessary to accomplish this, provide additional chutes or hoppers. Place concrete continuously, in layers not over 24 inches high at deep sections and not over 10 inches in height at shallow sections, in thinner layers if necessary so that fresh concrete will be placed against a layer that is still soft, except at approved joints. Vibrators shall not be used to push concrete laterally in the forms. Remove any wood spreaders as concrete rises in the forms.

3-3.4.8.4 Compaction.- Thoroughly compact concrete during and immediately after placement by means of mechanical vibrators. Demonstrate working condition of vibrator before concrete is ordered from the batch plant. Avoid over vibrating concrete to an extent which might cause segregation of aggregate.

3-3.4.8.5 Bond.- Before depositing new concrete against set concrete, inspect forms and have them tightened if necessary. Thoroughly clean reinforcing and surface of set concrete to remove foreign matter and laitance. Saturate surface with water. Slush vertical or inclined surface of set concrete with grout coating composed of 1:1-1/2 cement:sand, and place new concrete before grout has attained its initial set.

3-3.4.8.6 Forms.- If forms become displaced in any way during placing of concrete, immediately stop the operation and do not resume placing until forms have been rebraced and brought back to required lines and levels.

3-3.4.9 Structural concrete - special requirements.-

3-3.4.9.1 Excavated areas.- Excavation must be inspected and approved before concrete is placed. If excavations have been carried beyond the level shown on the Drawings without approval, fill the extra depth with concrete of the same strength as that required for footings without added cost to the Government. **Do not place concrete on wet or soggy ground without first laying and compacting a bed of crushed stone or gravel of sufficient thickness to keep the mud from mixing with the concrete.** Where water is present it must be kept below the level of the newly placed concrete continuously during placing and for at least 24 hours thereafter. The excavated area must be so prepared that the water will easily drain to the pump without carrying any cement with it.

3-3.4.9.2 Subgrade walls.- N/A

3-3.4.9.3 Slabs – N/A

3-3.4.9.4 Construction joints - Have bulkhead, if any, removed and prepare hardened surfaces as specified in paragraph 3-3.4.8.5.

3-3.4.9.5 Equipment pads.- (Not Used)

3-3.5 Quality assurance.-

3-3.5.1 Submittals.- Conform to procedures specified. Concrete source submission - Before ordering, submit and obtain approval of source of concrete when it is ready mixed, source of dry-batch material, or source of material for job mixing, as applicable. Contractor shall submit all batch slips to the COTR as the truck arrives on site.

3-4 FINISHING AND CURING

3-4.1 General.-

3-4.1.1 Scope.- Finish and cure the cast-in-place concrete including concrete required for the following work:

Tower Foundation

3-4.1.2 Related work in other sections.-

Other work required to be cast or set in concrete: Furnished and located under various other Sections.

3-4.2 Applicable documents.- The following specifications and standards of the issues currently in force form a part of this section, and are applicable as specified herein.

3-4.2.1 Federal Specifications.-

UU-B-790	Building Paper, Vegetable Fiber: (Kraft, Waterproofed, Water Repellent and Fire Resistant)
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3-4.2.2 American Society for Testing and Materials (ASTM) Publications.-

C171	Sheet Materials for Curing Concrete
C881	Epoxy-Resin-Base Bonding Systems for Concrete

3-4.2.3 American Concrete Institute (ACI).-

301	Structural Concrete for Buildings Chapters 1, 4, 9, 10, 11 and 18
302	Recommended Practice for Concrete Floor and Slab Construction

3-4.2.4 U.S. Department of Commerce Commercial Standards (CS).-

CS238 Polyethylene Sheet

3-4.3 Materials.-

3-4.3.1 Waterproof paper.- ASTM C171, Type I or Federal Specification UU-B-790 reinforced Kraft paper.

Glas-Kraft, Inc. - Glas-Kraft Grade A
St. Regis Paper Co. - Sisalkraft Sk-10
Or approved equal.

3-4.3.2 Plastic sheet.- U.S. Commercial Standard CS238 polyethylene sheet in 4 mil minimum thickness.

3-4.4 Installation.-

3-4.4.1 Relation with other trades.- N/A

3-4.4.2 Tolerance - horizontal surfaces.-

3-4.4.2.1 Standards.- Conform to ACI 301 Chapter 11 and ACI 302, unless modified or exceeded by the following requirements:

3-4.4.2.2 General.- Edges of areas shall be level and true to line against forms. Screed surface using specially fabricated straightedges (not lengths of lumber) and wet screeds.

3-4.4.2.3 Class A tolerance.- In addition to the Standards, limit deviation to slope of 1/8 inch in 5 running feet. Required for interior slabs.

3-4.4.3 Finishes.-

3-4.4.3.1 Standards.- Conform to ACI 301 Chapter 11 unless modified or exceeded by the requirements of this Specification.

3-4.4.3.2 Construction joints.- N/A

3-4.4.3.3 Slabs, pads and aprons.- Steel trowel finish - Power trowel where practicable, then hand trowel according to Standards.

Interior surfaces - After power troweling, hand trowel in 2 additional operations.

Exterior surfaces (aprons) - Trowel and medium broom finish with edges and joints finished with edging tool. Broom after concrete is hard enough to retain a scoring. Exterior surfaces (pads) - Trowel finish with edges finished with edging tool.

3-4.4.4 Repair of defects.- Concrete surfaces that are visible, that receive another material as finish shall be free of defects and shall be smooth. Immediately after removal of forms, cut off metal ties, chip out

adjacent surface to permit proper patching, cut out honeycomb areas, and remove fins. At holes and cracks, point areas flush using epoxy bonding agents and epoxy mortar, ASTM C881, Type 111C, grey. Install and cure in accordance with manufacturer's directions.

3-4.4.5 Curing.-

3-4.4.5.1 General requirements.- Protect concrete from loss of moisture, rapid drying or temperature changes, injurious action by the sun, rain, flowing water, or frost, and mechanical injury, at a temperature not less than 50 degrees F., from the time of placing until the end of the time of curing. Keep wood forms, left in place during curing, damp at all times to prevent opening at the joints and drying of concrete. No period during which moisture or warmth is lacking shall be counted effective for curing.

3-4.4.5.2 Methods.-

3-4.4.5.2.1 Duration.- Cure concrete for at least 7 days. During curing time do not work on or allow traffic on slabs being cured.

3-4.4.5.2.2 Moist curing.- Use one of the following methods:

Cover surface with cotton, burlap or insulated tarp mats. Keep surface covering constantly wet.

Cover surface with wetted burlap mats, placing burlap side down. Lap joints between mats 3 inches or more.

3-4.4.5.2.3 Impervious sheet curing.- Wet surface with fine spray then cover it with plastic sheet or waterproof paper. Lap joints at least 4 inches and seal with tape. Weight sheeting to prevent displacement. Repair tears and other damage.

3-4.4.5.3 Locations.-

3-4.4.5.3.1 Interior and exterior slabs.- Use moist curing or impervious sheet method.

END OF SECTION 3

13-1 ANTENNA TOWERS -

13-1.1 General.- The contractor shall supply and furnish all materials, labor, tools, etc. required to provide and erect the steel RTR Tower Kit. The contractor shall construct the tower foundation, assemble and erect the tower, install antenna mounts, lightning protection and electrical items as shown and perform all associated work indicated on drawings. The contractor shall secure the tower platform level grating as indicated on the Drawings. Lightning protection shall be furnished and installed by the contractor in accordance with the drawings and specifications.

13-1.2 Materials.- The tower kit shall consist of material to erect one – 10 foot high self supporting tower with a 16ft square platform, walk-up stairway, eight antenna mounts, lightning arrestor with support pole, OSHA approved platform railings, obstruction lights. The materials shall be unloaded and safely stored in bundles at the site until erected. Nuts and bolts shall be furnished for the tower. The contractor shall furnish additional nuts and bolts as required.

13-1.3 Installation.- The contractor will be responsible for; providing, assembling and erecting the entire tower, including the preassembled parts and checking all torque values as listed under the tower erection specifications. The grating shall be held snug to the tower support and abutting each outside member. The gratings shall snugly abut each other so as not to provide a difference in height between them of 1/4" or more.

13-1.3.1 Methods.- Construction procedures and erection sequence shall be consistent with the plans and specifications and shall be designed to result in a safe and expeditious completion of work. Any method of erection that results in permanent deformation or warpage of members will be discontinued and all damaged parts replaced or repaired. It is the intent of this contract for all procedures recommended in the manufacturer's printed instructions to be followed.

13-1.3.2 Base Plates.- bolted and leveled with supplied leveling nuts to the tower foundation anchor bolts.

13-1.3.3 Anchor bolts or anchor angles.- All locations of embedded items, and base elevations shall be checked by the COTR prior to the placement of footing concrete. Any discrepancies between actual field conditions, manufacturer drawings or FAA shall be reported to the COTR prior to installation.

13-1.3.4 Grout.- use non-shrink High Strength 5000psi min. between base plates and foundations.

13-1.3.5 Alignment.- True alignment must be maintained as the work progresses and on completion the structure must be plumb and true. If the error in alignment and true shape does not exceed 1/2 inch per 10 feet of tower the structure shall be considered in alignment.

13-1.3.6 Bolting -

13-1.3.6.1 Hardware.- Normally, nuts will be on the outside of vertical members and on the bottom of horizontal members and shall be tight on completion of work. Washers for the steel tower shall be placed under each nut between the member and the nut. The correct length bolts shall be used at each connection so enough bolt extends through the nut to accommodate a palnut. After the nuts have been taken up to a firm bearing, a palnut shall be attached to each bolt with lips pointing outward and the flat surface of the

palnut bearing against the tower bolt. The palnut shall be tightened firmly, but not so tight as to shear the palnut thrust plates. The bolts shall be tightened with either hand or calibrated torque wrenches.

13-1.3.6.2 Wrenches.- The suggested overall length of hand wrenches used during the erection of steel work for structural grade bolts is as follows: 3/8" diameter bolt, 8" wrench; 1/2" diameter bolt, 9.5" wrench; 5/8" diameter bolt, 11" wrench; 3/4" diameter bolt, 13" wrench; except that special wrenches are furnished for the palnuts. The bolt torque for the above or other size or type wrench shall correspond to the values listed in the table below for applicable size and type of bolt.

13-1.3.6.3 Torque Wrenches.- Calibrated torque wrenches shall show by dial or automatic release, the measure in foot-pounds of the torque induced by the wrench. The minimum torque for the sizes of bolts shall conform to the values listed below.

BOLT TENSION AND TORQUE VALUES

Bolt Size (in.)	Recommended Bolt Tension for Calibrating Wrenches (lb.)	Required Bolt Tension (lb.)	Required Bolt Tension (lb. Ft.)
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STRUCTURAL GRADE BOLTS Per ASTM Specifications A307

1/2	4,500	3,900	32
5/8	7,150	6,250	65
3/4	10,550	9,200	115

Per Federal Specification FF-B-575 (Type I Grade 2)

1/2	5,650	4,900	41
5/8	8,300	7,250	75
3/4	12,300	10,700	134

HIGH STRENGTH BOLTS Per ASTM Specification A325

1/2	12,500	10,850	90
5/8	20,000	17,250	180
3/4	29,000	25,600	320

The torque wrenches shall be properly calibrated and the nuts shall be in motion when the torque is measured. When using a power wrench, the recommendations of the wrench manufacturer shall be consulted in its operation and care shall be taken that the machine is maintained in proper working condition and proper calibration.

13-1.3.6.4 Error and Damage Correction.- Minor errors which can be corrected by a moderate use of drift pins or moderate cutting, reaming, or chipping shall be corrected by the contractor. Other errors shall be corrected in a manner approved by the COTR. Members which have suffered damage shall be repaired

or replaced to “as new” condition before use in the structure. The contractor shall report major damage to materials to the COTR immediately after receiving delivery.

13-1.3.6.5 Field Welding.- Field Welding, unless shown on the drawings, will not be permitted without the approval of the COTR.

13-1.3.6.6 Galvanized Finish Repair.- Any abrasions of the zinc coatings shall be touched up with a minimum of two coats of galvanizing paint. Galvanizing paint shall conform to Military Specification MIL-P-21035.

13-1.3.6.7 Lightning Rods.- Air Terminals shall be contractor furnished and installed within the center of the tower platform as shown on the drawings. The lightning rod and the tower shall be grounded as shown on the drawings. The contractor shall furnish and install sufficient lengths of galvanized rigid steel pipe, 2 inches in diameter (or as provided by tower manufacturer) to provide an overall total height to the tip of air terminal of 26 feet above the tower platform elevation.

13-1.3.6.8 Tower Wiring.- The contractor shall furnish all electrical items for the tower as shown on the drawings.

SEE APPENDIX “B” FOR TOWER DESIGN SPECIFICATIONS

13-2 Demolition

13-2.1 **General**.- after the new RTR tower is completely erected, and the FAA has performed all its necessary electronic and cabling work in order to successfully “cut-over” the existing RTR radios and antennas to the new fiberglass RTR shelter and steel tower, the contractor shall:

- Demo completely and remove from the site the old RTR trailer (and foundations), along with it’s asbestos flooring, lighting ballasts, mercury thermostat, fluorescent bulbs, and any other identified associated hazardous materials. Contractor shall follow and adhere to both Mass State and all applicable Federal Regulations for the proper removal, handling and disposal of all known hazardous materials.
- Demo completely the existing 8ft wide x 8ft high x 25ft long steel antenna tower, and its foundation, in entirety. The tower is painted with orange “Lead based” paint. Contractor shall adhere to all Mass State and all applicable Federal codes and regulations with regards to proper removal, handling, and disposal of all materials containing lead paint.
- After foundations have been removed to a minimum of 12 inches below grade, level and grade area and add loam, sod and seed as required to match surrounding areas.

END OF SECTION 13

16-1 ELECTRICAL WORK -

16-1.1.1 Power Scope.- Purchase and install new conduits and wires shown on the drawings from the new building to the tower. The size and quantity of all conduits is shown on the drawings. Purchase and install new junction box on the platform of the tower as shown on drawings. Install two power feeds from the new RTR building to the antenna tower platform, one circuit shall be for the OB light and the second shall be for the convenience outlet and for one flood light. Install two 3-way light switches for the tower platform flood light. One switch shall be located at the base of the staircase and one switch shall be located at the flood light. Also install one flood light with a switch by the entrance of the new RTR shelter

16-1.1.2 Lightning Protection & Grounding Scope.- The scope of this section also includes the grounding and counterpoise of the new tower (and shelter counterpoise), by means of cad-welding to new ground rods, installation of new ground cables between the new counterpoise at the tower and the existing counterpoise at the RTR building. Install a new air terminal and two Thompson 28 lightning down conductors on the tower as shown on the drawings.

16-1.1.3 General - This specification covers the minimum requirements for all electrical work pertaining to the site installation of the new Remote Receiver communication tower. Where the phrase "unless otherwise indicated" or similar wording appears, it refers exclusively to other documents that are specific parts of this contract.

16-1.2 APPLICABLE DOCUMENTS.- The current issues of the following documents in effect on the date of the invitation for bids form a part of this specification, and are applicable to the extent specified herein.

16-1.2.1 Federal Specifications

J-C-30	Cable and Wire, Electrical (Power, Fixed Installation)
W-C-582	Circuit Breakers, Molded Case; Branch Circuit and Service Conduit, Raceway, Metal, and Fittings; Surface
W-C-586	Conduit Outlet Boxes, Bodies, and Entrance Caps, Electrical: Cast Metal - For Shore Use
W-C-1094	Conduit and Conduit fittings; Plastic, Rigid
W-J-800	Junction Box; Extension, Junction Box: Cover, Junction Box (Steel, Cadmium or zinc - Coated)
W-P-115	Panel, Power Distribution
W-S-610	Splice, Connector
W-S-865	Switch, Box (Enclosed), Surface Mounted

WW-C-540	Conduit, Metal, Rigid: and Coupling, Elbows, and Nipple, Electrical Conduit: Aluminum
WW-C-563	Conduit, Metal, Rigid: Electrical, Thin Walled Steel Type (Electrical Metallic Tubing); Straight Lengths, Elbows, and Bends
WW-C-566	Conduit, Metal, Flexible
WW-C-581	Conduit, Metal , Rigid; and Coupling, Elbow and Nipple, Electrical Conduit: Zinc Coated
QQ-W-343	Wire, Electrical, (uninsulated)

(To obtain copies of federal specifications, contact General Services Administration offices in Washington DC, Atlanta, Boston, Chicago, Dallas, Denver, Kansas City MO, Los Angeles, New York, San Francisco, or Seattle.)

16-1.2.2 Military specifications

MIL-R-21931	Resin, Epoxy
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(Single copies of military specifications, standards, and handbooks may be requested by mail or telephone from Naval Forms and Publications Center, 5801 Tabor Ave., Philadelphia, PA 19120. Not more than five items may be ordered on a single request; the invitation for bids or contract number should be cited where applicable. Only latest revisions (complete with latest amendments) are available; slash sheets must be individually requested. Request all items by document number. For information on subscription service, direct inquiries to the above address with additional marking, "ATTN: CODE 56."

16-1.2.3 Federal Aviation Administration specification

FAA-STD-019e	Lightning Protection, Grounding, Bonding and Shielding Requirements for Facilities
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16-1.2.4 National Fire Protection Association (NFPA) publications

No. 70	National Electrical Code (NEC)
No. 780	Lightning Protection Code

(Requests for copies of NFPA publications should be addressed to the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.)

16-1.2.5 National Electrical Manufacturers Association (NEMA) standards

OS 1	Sheet Steel Outlet Boxes, Device Boxes, covers and Box Supports
ST 20	Dry Type Transformers for General Applications

VE 1 Cable Tray Systems

WC 5 Thermoplastic Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

WD 1 General Requirements for Wiring Devices

(For copies of NEMA standards, contact the National Electrical Manufacturers Association, 155 East 44th St., New York, NY 10017.)

16-1.2.6 Underwriters' Laboratories, Inc. (UL) standards

UL 50 Cabinets and Boxes

UL 96A Installation Requirements for Lightning Protection Systems

(For copies of UL standards, contact Underwriters' Laboratories Inc., Publication Department, 333 Pfingsten Rd., Northbrook, IL 60062.)

16-1.2.7 Institute of Electrical and Electronics Engineers (IEEE), Inc. Standards

STD C57.12.80 IEEE Standard Terminology of Power and Distribution Transformers

STD 141 IEEE Recommended Practice for Electric Power Distribution for Industrial Plants

(For copies of this standard, contact the IEEE, Inc., Standards Department, 445 Hoes Lane, PO Box 1331, Piscataway, NJ 08855-1331.)

16-1.3 MATERIALS -

16-1.3.1 General.- The contractor shall furnish all materials not specifically identified as Government Furnished Materials in the specification section 1-4. Materials and equipment shall comply with all requirements of the contract documents. Materials furnished by the contractor shall be new, the standard products of manufacturers regularly engaged in the production of such materials, and of the latest designs that comply with the specification requirements. If materials and equipment requirements conflict, the order of precedence shall be referenced FAA specifications, Military specifications, Federal Specifications, NFPA publications, IEEE standards, UL standards and NEMA standards. Wherever standards have been established by Underwriters' Laboratories, Inc., the material shall bear the UL label.

16-1.4 INSTALLATION

16-1.4.1 General.- The rules, regulations and reference specifications enumerated herein shall be considered as minimum requirements. FAA requirements often exceed those of other standards organizations such as the NEC. Adherence to other standards shall not relieve the contractor from furnishing and installing higher grades of materials and workmanship when so required by this specification. Adherence to this specification shall not relieve the contractor from furnishing and installing higher grades of materials and workmanship when so required by the contract drawings or special contract

provisions. This specification shall govern when conflicts occur between it and the documents referenced in paragraph 16-1.2, Applicable Documents, and in the order of precedence established in paragraph 3, Materials.

16-1.4.2 Workmanship.- All materials and equipment shall be installed in accordance with the contract drawings. When manufacturers recommended installation methods conflict with the contract requirements, differences shall be resolved by the COTR. The installation shall be accomplished by skilled workers regularly engaged in this type of work. Where required by local regulations, the workers shall be properly licensed.

16-1.4.3 Contract Drawings.- Where the electrical drawings indicate (by diagram or otherwise) the work intended and the functions to be performed, even though some details are not shown, the contractor shall furnish all equipment, material (other than Government furnished materials) and labor to complete the installation work and to accomplish all the indicated functions of the electrical installation. Furthermore, the contractor shall be responsible for taking the necessary actions to ensure that all electrical work is coordinated and compatible with architectural, mechanical, and structural items, and the layout of any special electronic equipment.

16-1.4.3.1 Minor Departures.- Minor departures from exact dimensions shown in electrical plans may be permitted when required to avoid conflict or unnecessary difficulty in placement of a dimensioned item, provided all contract requirements are met. The contractor shall promptly obtain approval from the COTR prior to undertaking any such departure and shall provide appropriate documentation of the departure.

16-1.4.4 Grounding

16-1.4.4.1 General.- FAA grounding requirements often exceed those of the National Electrical Code (NEC). Therefore, grounding systems shall be as indicated on the contract drawings and as specified herein. In no case, however, shall the NEC be violated.

16-1.4.4.2 Grounding electrode conductor.- The grounding electrode conductor shall be bare copper unless otherwise indicated and shall be sized as shown on the contract drawings

16-1.4.4.3 Grounding electrode system.- The grounding electrode system shall be installed as indicated on the contract drawings. The ground rods shall be 3/4" diameter copper clad, 10 feet long. The rods shall be interconnected by a bare copper #4/0 (7-Strand) counterpoise cable cad-welded to itself to form a closed loop around the structure. The counterpoise cable shall be a minimum No. 4/0 AWG 7-Strand copper and shall be buried at least 2 feet below grade. The top of the vertically driven ground rods shall be a minimum of 12" below grade. **All underground connections shall be made by the exothermic welding process unless otherwise indicated.**

16-1.4.4.4 Grounding electrode system resistance.- The resistance of the grounding electrode system shall not exceed 10 ohms, as tested **BY THE CONTRACTOR** with an approved null reference ground tester. **Contractor shall provide the COTR with three copies of the test results.** If the measured resistance exceeds 10 ohms, the COTR shall be notified immediately for further guidance. The contractor is responsible for the test.

16-1.4.4.5 Equipment grounding conductor.- Install #12 green wires to all metal non-current carrying parts of new electrical equipment of this contract per NEC.

16-1.4.4.5.1 Size.- All metallic non-current carrying parts of electrical equipment shall be grounded with equipment grounding conductors whether or not shown on the drawings. Equipment grounding conductors shall be green insulated copper conductors unless otherwise indicated. When these conductors are not sized, or shown on the contract drawings, they shall be sized in accordance with Table 250-95 of the NEC (1999 edition), entitled "Minimum size Equipment Grounding Conductors for Grounding Raceway and Equipment." In no case, however, shall these conductors be smaller than No. 12 AWG.

16-1.4.4.5.2 Connections.- Equipment grounding conductors shall be connected to the grounded conductor (neutral) **only at the service disconnecting means** and at separately derived systems. This connection is sometimes called the main bonding jumper. The equipment grounding conductor shall be installed in the same conduit as its related branch and feeder conductors and shall be connected to the ground bus in the branch or distribution panel board.

16-1.4.6 Raceway grounding.- Surface metal raceways, wire-ways, or cable rack systems shall be installed in a manner that assures electrical continuity, or sections to assure proper bonding. Unless otherwise indicated, the minimum size for these bonding jumpers shall be No. 6 AWG. Where aluminum raceways are used, the jumpers shall be bonded with approved connectors for the dissimilar metals. **The only interior grounding work required under this contract is as directed on the contract drawings.**

16-1.4.7 Other grounding systems.- (Not Used)

16-1.4.8 Lightning Protection.- Lightning protection systems where shown on the contract drawings shall be in accordance with the applicable parts of FAA-STD-019e and NFPA No. 780 and shall be installed to meet the installation requirements of UL 96A. All materials used shall be UL approved for use in lightning protection systems. Signal and power conductors shall be separated from lightning protection conductors to the maximum extent possible.

16-1.4.8.1 Connections below grade.- All underground connections from lightning protection system down conductors shall terminate at ground rods in the grounding electrode system with exothermic welds.

16-1.4.8.2 Transient protection.- The high energy transient ground bus for transient protection devices shall be connected directly to the grounding electrode system using the most direct path, without loops, sharp bends or kinks. The grounding conductor shall be an insulated #4/0 wire (7-strand).

16-1.4.9 Wiring methods

16-1.4.9.1 General.- Unless otherwise indicated, wiring shall consist of insulated copper conductors installed in conduit. In single phase systems (120 Volt, two wire and 120/240 volt, 3 wire), one grounded conductor (neutral) shall accompany each phase conductor pair (120/240 volt systems) powered from a circuit interrupting device. In 3 phase, wye, 4 wire systems, one grounded conductor (neutral) shall accompany the three related ungrounded conductors fed from a circuit interrupting device. All neutral conductors shall extend from the neutral bus in the device terminals for connection of more than one conductor shall be specifically designed for that purpose.

16-1.4.9.2 Raceway system.- Minimum conduit or tubing size shall be 3/4-inch unless otherwise specified. Each run shall be complete, and shall be fished and swabbed before conductors are installed. Ends of conduit systems not terminated in boxes or cabinets shall be capped. Exposed raceways shall be installed parallel to or at right angles with the lines of the structure. Crushed or deformed raceways shall not be installed. **A pull wire shall be installed in all empty tubing and conduit systems in which wiring is to be installed by others. The pull wire shall be No. 14 AWG zinc coated steel, or plastic with a minimum 200 pound tensile strength. Twenty four inches of slack shall be left at each end of the pull wire.** Sections of raceways which pass through to damp, concealed, or underground locations shall be of a type allowed for such location by the NEC, and shall extend a minimum of 12 inches beyond the damp, concealed, or underground area. Where conduit has to be cut in the field, it shall be cut square using a hand or power hacksaw or approved pipe cutter using cutting knives. The cut ends of the field cut conduit shall be reamed to remove burrs and sharp edges. Where threads have to be cut on conduit, the threads shall have the same effective length and shall have the same thread dimensions and taper as specified for factory cut threads on conduit. **Where conduits penetrate walls or floors separating the building interior from the exterior, they shall be sealed to prevent moisture and rodent entry and to deter air transfer. In addition, where conduits penetrate walls separating individual temperature or humidity controlled areas, they shall be sealed to prevent air circulation. Sealing methods and sealants shall be in accordance with the NEC.**

16-1.4.9.2.1 Heavy wall zinc coated rigid steel conduit.- Rigid steel conduit conforming to Federal Specification WW-C-581. Rigid steel conduit may be used in all locations. For installation below slab, on-grade or underground, the conduit shall be factory coated with either 0.008 inch of epoxy resin per Spec MIL-R-21931, 0.020 inch of polyvinyl chloride or 0.063 inch of coal tar enamel per Specification MIL-P-15147, or shall be field wrapped with 0.01-inch thick pipe wrapping plastic tape applied with 50% overlap. **Fittings used underground shall be protected by field wrapping as specified herein for conduit.** All fittings used with rigid steel conduit shall be threaded type, of the same material as the conduit. Where conduits enter enclosures without threaded hubs double locknuts (one on each side of the enclosure wall) shall be used to securely bond the conduit to the enclosure. In addition, a metallic insulated bushing shall be installed on the interior threaded end of the conduit to protect conductor insulation. Any conduits entering or existing an exterior junction box from the side or top shall use a "Meyers" type water proof hub connector.

16-1.4.9.2.2 Electrical Metallic Tubing (EMT).- EMT shall conform to UL 797. EMT may be used only in dry interior locations, and where not subject to physical damage. EMT shall not be used on circuits above 600 volts nor in sizes greater than 3/4 inches in diameter. Fittings used with EMT shall be standard compression-type fittings designed for this type of EMT, unless otherwise indicated. Screw –type fittings are not acceptable. Where EMT enters enclosures without threaded hubs, an appropriate connector with threads and cast or machined (not sheet metal) locknut shall be used to securely bond the conduit to the enclosure. The connector body and locknut shall be installed so that firm contact is made on each side of the enclosure. In addition the connectors shall have an insulated -throat, smooth bell shaped end, or a bushing.

16-1.4.9.3 Rigid plastic conduit.- Rigid plastic conduit shall be heavy wall PVC (schedule 40 minimum) conforming to Federal Specification W-C-1094, Type II. Rigid plastic conduit used to protect electrical power conductors may only be used underground, in concrete or as shown on the contract drawings for a special purpose. A PVC threaded fitting with locknut and plastic bushing shall be used to connect PVC conduit to boxes or cabinets without threaded hubs. Rigid plastic conduit may be used to protect lightning protection system conductors and, in interior locations, to protect signal grounding conductors.

16-1.4.9.4 Flexible steel conduit.- Flexible steel conduit shall conform to Federal Specification WW-C-566. The Minimum size shall be 3/4" diameter. Liquid-tight flexible conduit shall be used outdoors and in wet locations.

16-1.4.9.6 Square duct.- Wire-ways shall conform to UL 870, and shall only be installed in accessible locations. Wire-ways installed in wet or outdoor locations shall be rated for these locations.

16-1.4.9.7 Cable rack systems.- Cable rack systems shall be of the ladder or ventilated trough type conforming to NEMA Standard VE 1, unless otherwise indicated. All components for each cable rack system shall be the product of a single manufacturer. Cable rack support spacing shall be as recommended by the manufacturer except that in no case shall spacing of supports exceed 6 feet. Cable racks shall be supported from structural members only.

Straight sections, bends, tees, offsets, reducers, etc., for ladder -type cable rack systems shall consist of 3 inch minimum side channels with suitable cross channels (rungs) installed on 6 inch centers unless otherwise indicated. Straight sections, fittings, etc., for ventilated-type cable rack systems, shall have 3 inch minimum high sides and a ventilated bottom with cross pieces 2 inches (maximum) wide on 3 inch (maximum) centers and openings 2 inches (maximum) wide. Cable rack widths shall be as shown on the drawings.

16-1.4.9.8 Raceway support systems

16-1.4.9.8.1 General.- Raceways shall be securely supported at intervals specified by the manufacturer or as indicated by the NEC and fastened in place with pipe straps, wall brackets, hangers, or ceiling trapezes. Fastenings shall be by wood screws, nails or screw type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, or spring tension clamps on steel work. Nail type nylon anchors or threaded studs driven by a power charge and provided with lock washers and nuts may be used in lieu of expansion bolts, machine screws, or wood screws. Threaded C clamps with retainers may be used. Raceways or pipe straps shall not be welded to steel structures. Holes cut to a depth of more than 1-1/2 inch in reinforced concrete beams, or to a depth of more than 3/4 inch in reinforced concrete joists, shall not cut the main reinforcing bars. Holes not used shall be filled. Raceways shall not be supported from sheet-metal roof decks. In suspended ceiling construction, raceways shall not be fastened to the suspended ceiling supports.

16-1.4.9.9 Conductors

16-1.4.9.9.1 Uninsulated conductors.- Uninsulated conductors shall be copper and in accordance with Federal Specification QQ-W-343.

16-1.4.9.9.2 Insulated conductors.- Unless otherwise indicated, insulated conductors shall be copper with thermoplastic or thermosetting insulation, type THW, THWN, and XHHW for general use, or type THHN, for use in dry locations only, all insulated for 600 volts in accordance with Federal Specification J-C-30. Unless otherwise indicated, conductors No. 10 AWG and smaller shall be solid (unstranded), and conductors No. 8 AWG and larger shall be stranded. Minimum branch circuit conductor size shall be No. 12 AWG. Minimum control wire size shall be No. 14 AWG unless noted otherwise.

16-1.4.9.9.3 Color coding.- Feeder conductors to panels and to 3 phase circuits shall be color coded as specified herein. Single phase branch circuits may be color coded in a like manner or identified with heat shrink labels embossed with the feeder panel name and circuit breaker number at each end. The color coding shall be continuous throughout the facility on each phase conductor to its point of utilization so that the conductor phase connection is readily identifiable. Equipment grounding conductors shall be color coded as described in the national electrical code. Neutral conductors shall be continuous white or gray unless more than one voltage system is run in the Same raceway, box, or other type of enclosure. Neutral conductors of other systems shall be white or gray with identifiable colored tracers (not green). For conductors, No. 4 AWG and larger, where color coding is not available, color coded tape, half lapped for a minimum length of 3 inches shall be used. In no case, however, shall green insulated conductors be re-identified for purposes other than grounding (neutral) conductors. Where conductors are coded in this manner, they shall be color coded in all junction boxes and pullboxes, accessible raceways, panelboards, outlets and switches, as well as at all terminations. Conductors in accessible raceways shall be color coded so that conductors shall be color coded as follows:

Single Phase		Three-Phase	
<i>120 Volts</i>	120/208/(240) Volts	120/208/(240) Volts	277/480 Volts
Line – Black	Line 1 - Black	Phase A - Black	Phase A - Brown
	Line 2 - Red	Phase B - Red	Phase B - Orange
Neutral –White	Neutral - White	Phase C - Blue	Phase C - Yellow
		Neutral - White	Neutral - Gray/White

Color coding for conductors in control cables shall be in accordance with NEMA Standard WC-5. DC power conductors shall be color coded as follows: positive conductor, red with brown tracer; negative conductor, brown with red tracer.

16-1.4.9.10 Splices.- Splices shall be made only at outlets, junction boxes, accessible raceways. Splices shall be made with solderless connectors conforming to Federal Specification W-S-610. Wire nuts may only be used to splice conductors sized No. 10 AWG or smaller. Compression connectors shall be used to splice conductors No. 8 AWG and larger. All splices, including those made with insulated wire nuts., shall be insulated with electrical tape or heat shrink tubing to a level equal to that of the factory insulated conductors. Connections between aluminum and copper conductors shall be made only with materials approved for this purpose in accordance with the applicable portions of the NEC, and with devices approved for this purpose by UL.

16-1.4.9.11 Boxes.- Boxes shall be either the cast metal threaded hub type conforming to Federal Specification W-C-586, galvanized steel type conforming to Federal Specification W-J-800, or metal outlet boxes conforming to NEMA OS 1.

16-1.4.9.11.1 Applications.- Boxes shall be provided in the wiring or raceway system for pulling wires, making connections and mounting devices or fixtures. On exterior surfaces and in wet locations, boxes for metal raceways shall be of the cast metal threaded hub type. In hazardous areas, boxes shall be explosion proof. Boxes in other locations shall be cast metal threaded hub type or one piece galvanized steel with covers designed for surface installation. Non-metallic boxes may be used only with non-metallic raceway systems. Each box shall have the volume required by the NEC for the number and size of conductors in each box. Each outlet box shall have a machine screw which fits into a tapped hole in the box for the ground connection. Boxes for mounting lighting fixtures shall be not less than 4 inches square. Boxes installed for concealed wiring shall be provided with extension rings or plaster covers. The front edge of

the box shall be square cornered tile type covers. Cast metal boxes installed in wet locations and boxes installed flush with exterior surfaces shall have gaskets. Separate boxes shall be provided for flush or recessed fixtures where required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided. Boxes for fixtures on suspended ceilings shall be supported independently of the ceiling supports. Boxes shall not be supported from sheet metal roof decks.

16-1.4.9.11.2 Supports.- Boxes and supports shall be fastened to wood with wood screws, nails or screw type nails of equal holding strength, with bolts and expansion shields on concrete or brick, with toggle bolts on hollow masonry driven by powder charge and provided with lock washers and nuts, or nail type nylon anchors may be used in lieu of expansion shields, or machine screws. In open overhead spaces, cast metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and raceway shall be supported with an approved fastener not more than 24 inches from the box. Penetration shall be no more than 1-1/2 inches into reinforced concrete beams nor more than 3/4 inch into reinforced concrete joists. Main reinforcing steel shall not be cut.

16-1.4.10 Wiring devices

16-1.4.10.1 Receptacles.- Receptacles shall be of the voltage and current rating indicated on the drawings. All receptacles shall be specification grade in accordance with NEMA STD WD-1. Wiring terminals shall be of the screw type. Receptacles with push in connections or a combination of screw type and push in connectors are not acceptable. Unless noted otherwise, receptacles shall be installed 12 inches above finished floor. All receptacles, unless they are of the isolated ground type, shall be grounded by the installation of a green grounding pigtail from the receptacle grounding screw directly to the grounding lug on the outlet box where the green equipment grounding conductor is terminated. The equipment grounding conductor shall be installed with the receptacle power conductors and shall terminate at the ground bus in the electrical service panel.

16-1.4.10.1.1 Duplex receptacles.- Unless otherwise indicated, 250 volt receptacles shall be specification grade, grounded type with a minimum rating of 20 amperes (NEMA 6-20R per NEMA Standard WD-1).

16-1.4.10.3 Ground fault interrupting (GFI) receptacles.- GFI receptacles shall be installed in all locations required by the NEC and other locations as indicated on the drawings. Receptacles shall be 125 volt, duplex, UL Group I, Class A, rated for 20 amperes minimum. All exterior receptacles shall be mounted in weatherproof cast outlet boxes with weatherproof covers.

16-1.4.11.6 Safety Switches Safety switches shall be type "HD," heavy duty, locking type unless otherwise indicated. Switches mounted in dry locations shall be NEMA type 1 enclosures. Switches installed outdoors, or in damp locations shall be mounted in NEMA type 3R enclosures. Switches shall be of the voltage and current ratings indicated on the drawings. Switches shall be the quick-make, quick-break type. Except for ground lugs which shall be bonded to the housing, all parts shall be mounted on insulating bases to permit replacement of any part from the front of the switch. All current-carrying parts shall be of high-conductivity copper unless otherwise specified. Switch contacts shall be silver-tungsten or plated to minimize corrosion, pitting and oxidation. When used for motors a safety switch shall be sized in accordance with NEC Article 380. Switches shall disconnect all ungrounded conductors.

16-1.4.16 Identification.- Motor controllers, panelboards, safety switches and self-enclosed circuit breakers shall be identified with a name plate showing the functional name of the unit, voltage utilized, the number of phases, and other pertinent formation. Switches for local lighting need not be identified. Additional equipment shall be identified if called for on the drawings.

16-1.4.16.1 Name Plates.- Name plates shall be non-ferrous metal or rigid plastic, stamped, embossed or engraved with 3/8 inch minimum height characters. The plates shall be secured to the power boxes or electrical devices with a weather proof bonding material or minimum of two screws.

16-1.4.17 Fuses.- A complete set of fuses shall be installed and one set of spares shall be furnished for each fusible device. Time and current tripping characteristics of fuses serving motors or connected in series with circuit breakers shall be determined by the facility Protective Device Coordination Study (PDC). Fuses shall have a voltage rating not less than the circuit voltage. Required fuse interrupting ratings, determined by the Short Circuit Analysis (SCA) calculations, shall be as shown on the drawings, except that these interrupting ratings shall not be less than 100,000 amperes in branch and feeder circuits, and not less than 200,000 amperes in a service entrance switch.

16-1.4.18.2.2 Service Entrance Conduits.- Service entrance conduits shall be installed as shown on the drawings and shall be heavy wall zinc coated rigid steel unless otherwise indicated. Grounding bushings shall be installed on both ends of the service entrance conduit. Refer to specification FAA-C-1391 for installation of underground cables.

16-1.4.18.2.3 Underground conduits.- Underground conduits shall be installed a minimum of two feet below finished grade. Service entrance conduit shall be electrically continuous between the service disconnecting means and the facility transformer housing. **All underground couplings shall be made watertight; to make certain moisture and ground water does not permeate the joint. When using rigid metal conduit, a plumbers thread/seal type compound shall be used at each threaded underground connection.**

16-1.4.19 Painting and finishing.- Where factory finishes are not adequate to protect metal surfaces from corrosion, the contractor shall prepare and paint exposed surfaces prior to or after installation. All marred or damaged surfaces, except exposed metal for grounding purposes, shall be refinished to leave a smooth, uniform finish at final inspection.

16-1.4.20 Repair of existing work.- Electrical work shall be carefully planned. Where cutting, channeling, chasing or drilling of floors, wall partitions, ceilings, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, it shall be carefully done. The contractor shall repair, with equal material by skilled workers, any damage to facilities caused by the contractor's workers or equipment. Prior COTR approval must be obtained for the materials, workers, time of day or night, repair method, and for temporary or permanent repairs purposes. On completion, repair work shall be inspected and approved by the COTR with the concurrence of any other affected parties such as utility companies or airport officials.

16-1.5 QUALITY ASSURANCE PROVISIONS -

16-1.5.1 List of materials and equipment.- Within 15 days after receiving notice to proceed, and before installing any materials or equipment, the contractor shall submit six copies of the complete list of materials and equipment to the COTR for approval.

16-1.5.1.1 Information required.- This list shall include manufacturer's style or catalog numbers. Partial lists submitted from time to time shall not be considered fulfilling this requirement. Approval of materials will be based on manufacturer's published data. Approval of materials and equipment will be tentative, subject to submission of complete shop drawings when required and shall indicate complete compliance with the contract documents.

16-1.5.1.2 Statement.- A manufacturer's statement indicating complete compliance with the applicable federal specifications, military specification, or standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable as indicating compliance with contract documents.

16-1.5.2 Shop drawings.- When required by the contract or by direction of the contracting officer, the contractor shall submit shop drawings for materials and equipment not completely identified by information submitted in the materials and equipment lists. This information shall include, but is not limited to panelboards, lighting fixtures, cable trays, switchgear, transformers, busways, cabinets, and lightning protection systems. In addition, the contractor shall provide the completed Short Circuit Analysis/Protective Device (SCA/PDC) study, FAA Order 6950.27.

16-1.5.2.2 Required data.- Drawings and submitted data shall be complete, assembled in sets and shall bear the date, drawing revision number, name of project or facility, name of contractor and subcontractor, and the clear identity of contents and location of work.

16-1.5.2.3 Approval.- The approval of drawings and submitted materials will be general, but except as otherwise provided herein or in the contract, approval shall not be construed as (1) permitting any departure from the contract requirements; (2) relieving the contractor of the responsibility for any errors, including details, dimensions materials, etc.; or (3) approving departures from full size details furnished by the COTR.

16-1.5.2.4 Variations.- If drawings show variations from the contract requirements because of standard shop practice or for other reasons, the contractor shall describe such variations in a letter of transmittal to the COTR. If acceptable, the COTR may approve any or all such variations, subject to a proper adjustment in the contract. Contractors failing to describe such variations shall not be relieved of the responsibility for executing the work in accordance with the contract, even though such drawings have been approved.

16-1.5.2.5 Submission.- The contractor shall submit and obtain approval of shop drawings by the COTR before ordering materials or proceeding with any work associated with the shop drawings.

16-1.5.3 Tests -

16-1.5.3.1 General.- Unless otherwise indicated, the contractor shall furnish all test instruments, materials and labor necessary to perform the following tests. All tests shall be performed in the presence of the

COTR. All instruments shall have been calibrated within a period of two years preceding testing. Calibrations shall be retraceable to applicable industry standards.

16-1.5.3.2 Cables - N/A

16-1.5.3.3 Load balancing - N/A

16-1.5.3.4 Insulation resistance tests – N/A

16-1.5.3.5 Neutral isolation tests – N/A

16-1.5.3.6 Earth resistance test.- The contractor shall submit in writing to the COTR upon completion of the project the measured ground resistance of each ground rod indicating the location of the rod, resistance to ground, and the soil conditions at the time the measurements were made. After all ground rods are installed, they shall then be tied together with the counterpoise and the resistance to ground of the entire system shall be measured before and after the connection of the earth resistance tester. The maximum ground resistance shall be 10 ohms. Where additional ground rods are required to achieve the specified resistance, the COTR shall be notified before proceeding with additional work. The earth resistance test equipment and test procedures shall be by the Biddle Mfg. Co. or equal. **Contractor shall provide three copies of the report to the COTR.**

16-1.5.3.7 Operating Test.- After the interior wiring system installation is completed, and at such time as the COTR may direct, the contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements of this specification. The test shall be performed in the presence of the COTR.

16-2 FIBER OPTIC CABLE WORK -

16-2.1.1 Fiber Optic Cable Scope – Purchase and install new conduits, Sumitomo Tube cables, and Air blown fiber cables as shown on the drawings. The size and quantity of all conduits are shown on the drawings. Purchase and install new tube distribution boxes, fiber connectorized patch panels, and outdoor enclosures as shown on the drawings. Install new tube and fiber cables from the new 22L GS fiber demarc box to the new RTR shelter and 22L GS shelters. Re-route existing fiber cables from the existing RTR shelter to the 22L GS fiber demarc box. The fiber cables shall be terminated with a ST connectors as shown on the drawings.

16-2.1.2 General – For outside fiber cable installations; Massport requires the installation of “FutureFLEX” Air Blown Fiber throughout Massport’s properties.

Installations must use any authorized/licensed FutureFLEX contractor (hereafter referred to as the Contractor). The Contractor shall supply equipment, materials, labor, and services to provide the air blown fiber optic telecommunications distribution system including, but not limited to:

- 1) Indoor Tube Cables
- 2) Outdoor Tube Cables
- 3) Fiber Bundles
- 4) Tube Distribution Cabinets

- 5) Fiber Termination Cabinets
- 6) Optical Fiber Patch Cables
- 7) Splice Trays/ Cases
- 8) Connectors
- 9) Fiber Connector Interconnect Panels

16-2.1.3 References – Design, manufacture, test, and install air blown fiber telecommunications cabling networks per manufacturer's requirements and in accordance with NFPA-70 (National Electrical Code®), state codes, local codes, requirements of authorities having jurisdiction, and particularly the following standards:

1. ANSI/TIA/EIA-568-A Commercial Building Telecommunications Cabling.
2. ANSI/TIA/EIA-569-A Commercial Building Standard for Telecommunications Pathways and Spaces
3. ANSI/TIA/EIA-606 The Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
4. ANSI/TIA/EIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications
5. ANSI/TIA/EIA TSB-72 Centralized Optical Fiber Cabling Guidelines
6. ANSI/TIA/EIA TSB-75 Additional Horizontal Cabling Practices for Open Offices
7. ANSI/TIA/EIA-526-14A Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
8. ANSI/TIA/EIA-526-7 Measurement of Optical Power Loss of Installed Single-mode Fiber Cable Plant
9. ANSI/IEEE C-2 National Electrical Safety Code

Install cabling in accordance with the most recent edition of BICSI® publications:

1. BICSI Telecommunications Distribution Methods Manual
2. BICSI Cabling Installation Manual

Federal, state, and local codes, rules, regulations, and ordinances governing the work, are as fully part of the specifications as if herein repeated or hereto attached. If the Contractor should note items in the drawings or the specifications, construction of which would be code violations, promptly call them to the attention of the owner's representative in writing. Where the requirements of other sections of the specifications are more stringent than applicable codes, rules, regulations, and ordinances, the specifications shall apply

16-2.2.1 Quality Assurance – The contractor, that is installing the Sumitomo tube cables and air blown fiber bundles, shall be an authorized/licensed FutureFLEX Cabling System installer and shall provide documentation proving such.

Equipment and materials of the type for which there are independent standard testing requirements, listings, and labels, shall be listed and labeled by the independent testing laboratory.

Material and equipment shall be new, and conform to grade, quality, and standards specified. Equipment and materials of the same type shall be a product of the same manufacturer throughout.

Subcontractors shall assume all rights and obligations toward the contractor that the contractor assumes toward the owner and engineer.

16-2.2.2 Submittals - Within 15 days after receiving notice to proceed, and before installing any materials or equipment, the contractor shall submit six copies of the complete list of materials and equipment to the COTR for approval.

This list shall include manufacturer's style or catalog numbers. Partial lists submitted from time to time shall not be considered fulfilling this requirement. Approval of materials will be based on manufacturer's published data. Approval of materials and equipment will be tentative, subject to submission of complete shop drawings when required and shall indicate complete compliance with the contract documents.

The contractor shall submit and obtain approval of shop drawings by the COTR before ordering materials or proceeding with any work associated with the shop drawings.

16-2.2.3 Record Drawings – The Contractor shall provide and keep up-to-date a complete Record set of drawings which shall be corrected and shall show every change from the original specifications and Contract Drawings. These drawings shall include:

1. Conduit, tube cable, and fiber bundle detail.
2. All splice points and cross connect/ patch panel points.
3. Tube cable and fiber bundle routes.

16-2.2.4 Warranty – All materials, equipment, etc., shall be guaranteed by the Contractor for 10 years from date of completion of the work. This guarantee shall include all labor, material, and time travel.

16-2.3.1 Products – The Contractor shall furnish and install all tube cables, fiber bundles, connectors, and equipment as shown on drawings and as specified below.

16-2.3.2 Indoor Tube Cables – Indoor tube cables shall be composed of dielectric materials. The tube cable shall be suitable for installation in cable tray, plastic or metallic conduit, and conventional innerduct. During installation, tube cable ends are to be completely sealed to prevent ingress of contaminants, including water. The maximum bending radius shall be 20 times the cable diameter during installation and 10 times the cable diameter after installation. The tubes within the cables shall all have a uniform 6mm inside diameter and 8mm outside diameter. Upon completion of tube cable installation, all tubes shall pass the standard 150 psi pressure test and 5 mm ball bearing test per the cable manufacturer's recommended procedures. All unoccupied tubes shall be plugged on both ends.

16-2.3.3 Outdoor Tube Cables – Outdoor tube cables may be composed of dielectric and metallic materials. The tube cable shall be suitable for underground, buried, and aerial applications. Tube cables for buried applications shall be steel armored for rodent protection, and conductive material(s) shall be bonded and grounded. During installation, tube cable ends are to be completely sealed to prevent ingress of contaminants, including water. The tubes within the cables shall all have a uniform 6mm inside diameter and 8mm outside diameter. The maximum bending radius shall be 20 times the cable diameter during installation and 10 times the cable diameter after installation. Upon completion of tube cable installation, all tubes shall pass the standard 150 psi pressure test and 5 mm ball bearing test per the cable manufacturer's recommended procedures. All unoccupied tubes shall be plugged on both ends.

16-2.3.4 Fiber Bundles – Fiber bundles shall be provided based on immediate needs only. The contractor shall furnish and install optical fiber bundles as identified on the drawings. Fiber bundles shall not be spliced or patched at transition points from indoor to outdoor environments. Fiber bundles shall be

installed end to end or home run from MC to work area outlet whenever possible to minimize splicing and patching. Zero tensile stress shall be placed upon the fiber bundles during installation to eliminate micro-fractures within the glass fiber that result from pulling the optical fiber cable through innerduct systems. . The fiber bundles are UL listed for use in fire-rated tube cables. UV inked fibers are individually colored coded per TIA Standards. The fibers are contained in a clear nylon sub-unit/inner jacket. Black polyester ripcords are provided for entry into the nylon sub-units. Aerodynamic foamed polyethylene outer jackets to contain the sub-units and allow for long blowing distances.

16-2.3.5 Fiber Cable Specifications –

- a. Multi-mode 62.5/ 125 μm diameter optical fiber, with fiber counts as indicated on drawings, shall have the following specifications:
 1. Dual window, 850 nm and 1300 nm.
 2. Minimum bandwidth – 220 MHz-km at 850 nm, 600 MHz-km at 1300 nm.
 3. Maximum attenuation – 3.50 dB/km at 850 nm, 1.5 dB/km at 1300 nm
- b. Single-mode 8.7 μm / 125 μm diameter optical fiber, with fiber counts as indicated on drawings, shall have the following specifications:
 1. Dual window, 1310 nm and 1550 nm.
 2. Maximum attenuation – 0.50 dB/km at 1310 nm, 0.50 dB/km at 1550 nm

16-2.3.6 Tube Distribution Cabinets (TDC) – A NEMA-type enclosure, suitable for the site environmental conditions (i.e. NEMA 1 for indoor use) shall be provided for tube distribution, routing, and termination. TDCs shall be installed as shown in the drawings, wherever several cables enter the same location, where cable type transitions take place, or where cables terminate. The contractor is responsible for selecting the TDC hardware to meet site conditions. Choose TDU size based on the number of tubes to enter the unit. TDCs shall be wall-, floor-, rack-, or ceiling-mounted to provide better protection and geometry for distribution. If rack-mount fiber termination hardware is required, wall-mount a TDC near the rack and use individual tube cabling (provided with the fiber termination unit) to route and connect fiber bundle passing through the TDC to the fiber termination hardware.

16-2.3.7 Fiber Termination Cabinet (FTCs) - A suitable enclosure shall be provided at all locations where fiber is to be terminated. FTCs shall provide for strain relief of incoming tube cables as well as providing connector panels and connector couplings adequate to accommodate the number of fibers to be terminated. All FTCs shall incorporate radius control mechanisms to limit bending of the fibers to the manufacturer's recommended minimums or 1.2", whichever is larger.

All terminated fibers shall be mated to specified couplings (ST) mounted on patch panels. Couplers shall be mounted on a panel that, in turn, snaps into the housing assembly. Panels shall be available to accommodate a changing variety of connector types. All FTCs shall have a common key lock that opens all FTCs installed for this project. The contractor is responsible for selecting the FTC hardware to meet site conditions. Size FTCs to accommodate the total fiber count to be installed at each location as defined in the drawings. FTCs shall be wall-or rack-mounted as specified in the drawings.

16-2.3.8 Splice Cases – A suitable splice case shall be provided at all man-hole locations where tube cables are spliced. Splice cases shall provide for strain relief of incoming tube cables and be suitable for the environment where installed. All splice cases shall be of the same manufacturer as the tube cables being used and shall be installed per manufacturer's specification.

16-2.3.9 Connectors – The connector type shall be ST . The connectors shall be stainless steel epoxy type, with ceramic tips. The connectors shall sustain a minimum of 200 mating cycles per EIA/ TIA-455-21 without violating specifications. The connector performance shall be within industry normal limits. The attenuation per mated pair shall not exceed 0.75 dB (individual) and 0.5 dB (average).

16-2.3.10 Fiber Pigtail Termination – All fiber pigtails shall be approximately 1 meter long, have a 900 micron buffer, with a factory terminated ST connector per paragraph 16-2.3.9.

16-2.3.11 Splices – All fiber splices shall be fusion splices. Splice performance shall be within industry accepted limits or as specified in TIA/EIA 568 (≤ 0.3 dB loss per splice). All splices shall be protected in a splice protector and placed in splice trays that are attached inside a splice enclosure/ TDC/ FTC.

16-2.4.1 Installation – The contractor shall install all tube cables, fiber cables, connectors, and splices per manufacturer's specifications.

16-2.4.2 Tube Cable Installation –

1. Prior to pulling tube cable, thoroughly swab conduits to remove foreign material before pulling cables.
2. Beginning installation means contractor accepts existing conditions.
3. Contractor shall furnish all required installation tools to facilitate cable pulling without damage to the cable jacket. Such equipment is to include, but not be limited to, sheaves, winches, cable reels, cable reel jackets, duct entrance funnels, pulling tension gauges, and similar devices. All equipment shall be of substantial construction to allow steady progress once pulling has begun. Makeshift devices which may move or wear in a manner to pose a hazard to the cable shall not be used.
4. Cable pulling shall be done in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 standards. Manufacturer's recommendations shall be a part of the cable submittal. Recommended pulling tensions and bending radii shall not be exceeded. Any tube cable bent or kinked to a radius less than recommended shall not be installed.
5. During pulling operation, an adequate number of workers shall be present to allow cable observation at all points of duct entry and exit as well as to feed cable and operate pulling machinery.
6. Pulling lubricant shall be used to ease pulling tensions. Lubricant shall be of a type which is non-injurious to the cable material used. Lubricant shall not harden or become adhesive with age.
7. Avoid abrasion and other damage to cables during installation.
8. Cable slack shall be provided in each cable. Follow recommended procedures from the manufacturer regarding length of slack cable ensuring a minimum of 5 meters (approximately 15 feet) of cable which shall be coiled and secured at each termination location. This slack is exclusive of the length of fiber that is required to accommodate termination requirements and is intended to provide for cable repair and/or equipment relocation. The cable slack shall be stored in a fashion as to protect it from damage. The use of suitable enclosures designed for this purpose is encouraged.
9. All exposed tube cable shall be labeled at 35-foot (maximum) intervals with tags indicating ownership, cable type, and fiber type installed.
10. Tube cable shall be riser- or plenum-rated if required by the installation environment.
11. Where not installed in a continuous length, tube cable segments shall be spliced using couplings designed for that purpose. Splices of under-ground tube cables shall be done in man-holes in a water-tight splice case per the tube cable manufacturer's specifications. Splice cases shall be

attached to the side of the man-hole. Splices made to tube cables above ground shall be made in a TDC per tube cable manufacturer's specifications.

12. Pressure testing and obstruction testing shall be performed prior to fiber bundle installation.

16-2.4.3 Fiber Bundle Installation –

1. Fiber bundles shall be installed according to manufacturer's recommendations and only by a factory licensed/certified installer.
2. Optical fiber cable bundles shall be continuously inserted and propelled or blown into the individual tubes or cells utilizing a compressed gas such as nitrogen as the propellant per the manufacturer's instructions. The blowing installation process and the fiber bundles must also be designed to allow removal, replacement, and reuse of the fiber bundles at any time in the future as deemed necessary by the owner.
3. Slack in each fiber bundle shall be provided as to allow for future re-termination in the event of connector or fiber end-face damage. Adequate slack shall be retained to allow termination at a 30" high workbench positioned adjacent to the termination enclosure(s). A minimum of 1 meter (39") of slack shall be retained at the work area, and a minimum of 3 meters (approximately 10') of slack shall be retained in equipment rooms and telecommunications closets.
4. All fibers in a bundle shall be put through a 900 micron tubing breakout kit prior to any terminations/ splices.
5. All optical fiber terminations/ splices shall be completed by qualified personnel utilizing state-of-the-art equipment and techniques.
6. The Contractor shall use industry standard means and methods for all fiber splices. All fiber splices shall be fusion splices (per paragraph 2.01.9). All splices shall be protected in a splice protector and placed in splice trays that are attached inside a splice enclosure/ TDC/ FTC, suitable to the environment.
7. All multi-mode fiber terminations shall be epoxy/ polish ST type connectors per paragraph 16-2.3.9 of this division or fusion spliced ST pig-tails per 16-2.3.10 of this division.
8. All single-mode fiber terminations shall be performed by fusion splicing factory-terminated pigtails per paragraph 16-2.3.10 of this division.

16-2.5.1. Testing – The contractor shall test all fiber cables before and after installation. The fiber cables shall be tested in accordance with manufacturers and FAA's test procedures. All cable testing shall be performed by the contractor in the presence of the COTR. The contractor shall furnish all necessary test equipment. All test equipment used shall have a valid certification of calibration which is traceable to a secondary standard.

16-2.5.2. Pre-Installation Testing - The contractor shall perform insertion loss testing of all existing fibers in the existing fiber cables prior to re-routing the cables to the new demarc box. Each fiber shall be tested with a light source and power meter utilizing procedures as stated in ANSI/TIA/EIA-526-14A: OFSTP-14 Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant and ANSI/TIA/EIA-526-7: OFSTP-7 Measurement of Optical Power Loss of Installed Single-mode Fiber Cable Plant. Measured results shall be plus/minus 1 dB of the submitted loss budget calculations. If loss figures are outside this range, test cable with an optical time domain reflectometer to determine cause of variation and report results to the COTR.

Each multi-mode fiber shall be tested at 850 nm and 1300 nm. Each single-mode fiber shall be tested at 1310 nm and 1550 nm.

1. Testing procedures shall utilize "Method B" – One jumper reference.

2. Bidirectional testing of optical fibers is required.

The contractor shall provide pressure test and obstruction test data for each tube installed.

The contractor shall provide the cable manufacturer's test report for each reel of fiber bundle provided. These test reports shall include manufacturer's on-reel attenuation test results at both 850 nm and 1300 nm for multi-mode and at both 1310 nm and 1550 nm for single-mode for each optical fiber of each reel prior to shipment from the manufacturer.

The contractor shall perform an attenuation test with an OTDR of each optical fiber of each fiber bundle reel prior to installation. The contractor shall supply this test data to the engineer prior to installation.

The fibers utilized in the installation shall be traceable to the manufacturer. On-the-reel bandwidth performance as tested at the factory shall be provided upon request.

Optical fiber bundle shall be tested before utilization as follows:

1. Test equipment – The contractor is responsible for supplying all equipment and personnel necessary to conduct the acceptance tests. The bidder should detail the proposed test plan for each cable type including equipment to use, test frequencies, and wavelengths, etc.
2. Contractor responsibility – The contractor shall conduct acceptance testing according to a schedule coordinated with the owner. Representatives of the owner may be in attendance to witness the test procedures. The contractor shall offer adequate advance notice (at least one week) to the owner as to allow for such participation.
3. Procedures – The contractor is to describe how they will conduct the tests and provide copies of all test results to the architect/engineer.

16-2.5.3. Post Installation Testing – The contractor shall perform an insertion loss test (per paragraph 16-2.5.1 above) and an attenuation test with an OTDR of each optical fiber of each fiber bundle after the installation. The contractor shall supply this test data to the engineer.

In the event that test results are not satisfactory, the contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests which disclosed faulty or defective material, equipment, or installation method, and shall perform additional tests as the engineer deems necessary. Any improper splices or damaged items shall be replaced at no charge to the FAA.

Tests related to connected equipment of others shall only be done with the permission and presence of the contractor involved. The contractor shall perform only that testing as required to prove the fiber connections are correct.

16-2.5.4. Test Documentation – Test results shall include a record of wavelength, fiber type, fiber and bundle number, fiber length, test equipment and model number, date reference setup, and operator (crew members).

The contractor shall provide written reports of all test data to the owner. At such time the contractor turns over test data to the engineer.

Two (2) record copies of all test data shall be submitted to the engineer for approval. The contractor shall notify the engineer at least one week in advance of the test date so that the engineer may be present.

16-3 COAX CABLE WORK -

16-3.1.1 Coax Cable Scope – Purchase and install Heliac coax cable, junction boxes, ground bars, and ice bridge as shown on the drawings. The coax cables shall run from the surge protectors inside of the new RTR shelter to a junction box on the platform of the new antenna tower.

All exterior hardware shall be stainless steel.

16-3.1.2 Ice Bridge Installation – The contractor shall purchase and install an ice bridge between the new RTR shelter and the new antenna tower as shown on the drawings. The ice bridge shall be sized for the distance between the shelter and the tower. The ice bridge shall be installed per manufacturer's specifications. The ice bridge shall include cable trapezes to support the coax cables. The cable trapezes shall be spaced approximately 3' apart. The contractor shall supply appropriate cable clamps to secure the coax cables to the cable trapezes as shown on the drawings.

16-3.1.3 Platform Cable Junction Box Installation – The contractor shall provide and install a junction box on the antenna tower platform as shown on the drawings. The junction box shall be attached to the railing of the tower with stainless steel hardware. The junction box shall contain a ground bar, N(F) – N(F) bulkhead adapters to transition the Heliac cables to the antenna coax cables, and liquid-tight connectors to allow the Heliac and antenna coax cables to enter the box. The ground bar shall be connected to the antenna tower counterpoise with a #4/0 insulated copper cable as shown on the drawings.

16-3.1.4 Coax Surge Protection Installation – The contractor shall provide and install two ground bars and coax surge protectors in the new RTR shelter as shown on the drawings. The ground bars shall be connected together and to the shelter counterpoise with a #4/0 insulated copper cable as shown on the drawings.

16-3.1.5 Coax Entry Panel Installation – The contractor shall provide and install a coax cable wall feed through plate with appropriate cable entry boots, as shown on the drawings.

16-3.1.6 Coax Cable Installation – The contractor shall provide and install Heliac cables from the surge protectors to the platform junction box as shown on the drawings. The cables shall be installed per manufacturer's instructions and specifications. The cables shall be rung without splices, bends, or sags and shall be tightly strung through cable supports every 3'. The cables shall be secured to the tower leg, with appropriate clamps, before entering the platform as shown on the drawings.

Each cable is to be terminated at both ends, once at the surge protectors inside the shelter and once at the tower junction box located on the antenna tower platform. All Heliac cables shall be terminated with N-male connectors. Cables terminated in the shelter shall be connected to the contractor supplied surge protectors as shown on the drawings. Cables terminated in the antenna tower junction box shall be connected to contractor supplied 50 ohm, N type, female/female bulkhead connectors as shown on the drawings.

16-3.2.1 Testing – The contractor shall test all contractor installed coax cables; after the cable and connector have been installed. The coax cables shall be tested in accordance FAA order JO6580.5A, section 3-2 parameter 3-30. External Transmission path. Method 1, 2, or 3 are acceptable. All cable testing shall be performed by the contractor in the presence of the COTR. The contractor shall

furnish all necessary test equipment. All test equipment used shall have a valid certification of calibration which is traceable to a secondary standard.

The length of each coax cable shall be determined by the contractor after the installation of each cable. An end to end attenuation test shall be performed by the contractor per FAA order JO6580.5A.

In the event that test results are not satisfactory, the contractor shall make adjustments, replacements, and changes as necessary and shall then repeat the test or tests which disclosed faulty or defective material, equipment, or installation method, and shall perform additional tests as the COTR deems necessary. Any malfunctioning or damaged items shall be replaced at no charge to the FAA.

16-3.2.2 Test Documentation

Test results shall include cable number/ identifier, cable length, test equipment and model number, date reference setup, and operator (crew members).

The contractor shall provide written reports of all test data to the owner. At such time the contractor turns over test data to the engineer.

Two (2) record copies of all test data shall be submitted to the engineer for approval. The contractor shall notify the engineer at least one week in advance of the test date so that the engineer may be present.

END OF SECTION 16

Appendix “A”

Soil Boring and Data Analysis Report – Logan Airport Boston MA

The FAA intends to construct a new Remote Transmitter Receiver (RTR) Antenna Tower at the Logan International Airport Boston, MA (Standby Receiver Site). The antenna tower will consist of a steel frame structure, 10ft in height, with a 16ft square platform.

- A. Provide a geotechnical engineer to coordinate and manage the subsurface investigation.
 - B. Provide one (1) soil boring with a truck-mounted drill rig. The boring will be advanced to depths of 25 feet at the location of the proposed antenna tower. Split spoon sampling will be conducted continuously to a depth of 10 feet and at standard 5-foot intervals thereafter to boring termination depth. Groundwater will be measured at the project site during drilling operations and upon completion of the borings.
 - C. Stake the boring in the field prior to the investigation from existing site features based on a provided site plan.
 - D. Provide a geotechnical engineer to supervise the subsurface investigation ensuring that proper drilling and sampling procedures are utilized. The engineer will also classify samples, obtain groundwater measurements, and prepare field logs documenting the observed subsurface conditions.
 - E. Provide a complete geotechnical engineering report including:
 - 1. a description of the subsurface investigation
 - 2. a description of the in-situ subsurface and geologic conditions
 - 3. subsurface logs and a boring location plan
 - 4. provide recommendation for applicable foundation type/design required for the antenna tower based on soil data.
 - 5. **provide information with respect to:** allowable bearing capacity at the depth required for the proposed bottom of footing locations, settlement estimates, site preparation, groundwater control, and other construction considerations.
- The contractor will be granted free and easy access to the project site and all properties contained therein.
 - The boring locations are truck-accessible; there is no need for an ATV-mounted drill rig for the performance of this work.
 - The drilling contractor will coordinate with the appropriate Dig Safely Authority prior to any work performed. Contractor shall ensure that all known utilities are located and shall utilize the latest available information: airport drawings, topographic survey's, etc. relative to that area prior to commencing work.

Appendix “B”

DESIGN AND FABRICATION OF ANTENNA TOWERS

PART 1 - GENERAL

1.1 SUMMARY

This specification sets forth the requirements for the design and fabrication of a self supporting antenna support tower and associated foundation for an air to ground communication system.

1.2 REFERENCES

The current issues of the following documents in effect on the date of the invitation for bid form a part of this specification and are applicable to the extent specified herein.

FEDERAL SPECIFICATIONS

RR-5-001301 Safety Equipment, Climbing

RR-G-661 Grating –Bar Type

MILITARY SPECIFICATIONS

MIL-M-17194 Metal, Expanded, Steel

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A-36 Carbon Structural Steel
A-53 Pipe, Steel Black and Hot Dipped, Zinc Coated , Welded and Seamless
A-123 Zinc (Hot Galvanized) Coatings on Iron and Steel Products
A-153 Zinc Coating (Hot Dip) on Iron and Steel Hardware
A-242 High Strength Low Alloy Structural Steel
A-307 Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
A-325 Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
A-385 Practice for Providing High Quality Zinc Coatings
 (Hot Dip)
A-490 Heat Treated Steel Structural Bolts 150 ksi Minimum Tensile Strength
A-501 Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
A-615 Deformed Billet and Plain Billet Steel Bars for Concrete Reinforcement
A-618 Hot Formed Welded and Seamless High Strength, Low Alloy Steel Tubing

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC) SPECIFICATION

Standard Practice for Steel Buildings and Bridges.

AMERICAN IRON AND STEEL INSTITUTE

Cold-Formed Steel Design Manual

AMERICAN WELDING SOCIETY WELDING HANDBOOK

D1.1 Structural Welding Code

ELECTRONIC INDUSTRIES ASSOCIATION

TIA-222-G Structural Standards for Steel Antenna Towers and Structural Supporting Structures

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

B18.22.1 Plain Washers

1.3 SUBMITTALS

1.3.1 Submittal Descriptions (SD)

Submittals are identified by SD numbers and titles as follows.

SD-02 Shop Drawings

Drawings, diagrams and schedules specifically prepared to illustrate some portion of the work.

SD-03 Product Data

Catalog cuts and brochures illustrating size, physical appearance and other characteristics of equipment .

SD-05 Design Data

Calculations, analyses or other data pertaining to a part of work.

1.3.2 Variations

When proposing a variation, deliver written request to the Contracting Officer, with documentation of the nature and features of the variation and why the variation is desirable and beneficial to Government. If lower cost is a benefit, also include an estimate of the cost saving. In addition to documentation required for variation, include the submittals required for the item. Clearly mark the proposed variation in all documentation. When delivering a variation for approval, Contractor warrants that this contract has been reviewed to establish that the variation, if incorporated, will be compatible with other elements of work.

1.3.3 Format of Submittals

1.3.3.1 Transmittal

Transmit each submittal to office of approving authority.

1.3.3.2 Format for SD-02 Shop Drawings

- a. Shop drawings shall not be less than 8 1/2 by 11 inches nor more than 30 by 42 inches.
- b. Include on each drawing the drawing title, number, date, and revision numbers and dates.
- c. Dimension drawings; Identify materials and products for work shown.

1.3.3.3 Format of SD-03 Product Data

Indicate, by prominent notation, each product which is being submitted; indicate specification section number and paragraph number to which it pertains.

1.3.3.4 Format of SD-05 Design Data and SD-07 Certificates

Provide design data and certificates on 8 1/2 by 11 inches paper

1.3.5 Quantity of Submittals

Submit two copies of submittals for approval by the Contracting Officer.

1.3.6 Submittals Required

SD -02 Shop drawings

Tower design fabrication, foundation and erection drawings

SD -03 Product data

Safety Climbing Devices

SD - 05 Design Data

Tower structural design calculations

PART 2 - PRODUCTS

2.1 ANTENNA SUPPORT TOWER DESIGN

2.1.1 General

Tower designed and furnished by the contractor shall be complete in accordance with all specification requirements including antenna support mounts, anchor bolts, walk-up stairway OSHA approved, protective grounding and lightning arrestor, OB lights, and all hardware essential for the erection of the tower. The contractor shall provide all materials supplies, equipment and services necessary to design, fabricate and prepare for delivery of all items listed in the contract schedule.

2.1.2 Tower Description

2.1.2.1 Four Leg Tower

The tower shall be a self supporting steel structure with a platform at the top for mounting and servicing antennas. The tower shall be designed to be shipped knocked down and to be erected in the field using only structural bolts. The tower shall be fabricated in 15 or 20 foot plus or minus sections except that a 10 foot section shall be provided to obtain the required height(i.e. 10, 30 or 50 feet) The tower members shall be fabricated from pipe, angular or solid stock. The tower shall have 4 legs (more are allowed if required, depending on platform size requested).

2.1.2.2 Support Arms and Antenna Mounts

The antennas will be installed on 2 ½ inch (ID) IPS Rigid steel pipes (2.87 inch OD) that extend approximately 6 inches above the platform top guard rail (48inches, supplied and designed by tower manufacturer). The antenna support mounts shall be spaced around the work platform to permit the installation of 8 antennas while maintaining a minimum of 8 ft separation from each other, and the lightning arrestor pole. This can be accomplished with a square platform measuring 16ft x 16ft. The contractor shall submit designs for the antenna mounts and their attachment to the tower.

2.1.2.3 Ladder

N/A

An OSHA approved (CFR 1910.24) walk-up stairway shall be required in place of a climbing ladder.

2.1.2.4 Work Platform and Guard Rails

The platform shall be fabricated of angle framing members and the floor of the platform shall be fabricated from either expanded metal grating or bar type grating. The floor shall be secured to the framing. The platform shall be provided with a guard rail composed of vertical posts with a top and intermediate rail located 42 inches and 21 inches respectively above the platform floor. A 4 inch high by 12 gauge toe board shall be secured to the inside of the guard rail posts located ¼" above the floor of the platform. The toe board shall run continuously around the perimeter. The perimeter framing members shall support the rails, toe board in addition to the required antenna mounting brackets.

2.1.2.5 Work Platform Access

Access to the tower shall be gained via and OSHA approved/designed (1910.24) walk-up stairway specific to the tower design.

2.1.2.6 Foundation

A PE certified/stamped (from the state where the foundation is to be located) foundation design shall be provided for the tower. The design shall be based on the safe soil bearing pressures data analyzed through means of soil borings conducted at the foundation location (see Appendix A). Concrete strength shall be based on a 28 day compressive strength of 3000 psi, and a maximum slump of 4". Reinforcing steel shall be intermediate grade billet ASTM A-615 grade 60 deformed bars. Foundation designs shall be oriented toward economical construction based on the costs of labor and materials at the time of the design.

2.1.3 Special Requirements

Unless otherwise indicated EIA Standard TIA-222-G shall govern the design and fabrication of the towers. The design shall be in accordance with AISC and AISI specifications and established engineering practices.

2.1.4 Service Conditions

Tower with a work platform, eight stacked VHF/VHF standard communications antennas located atop the structure, with ten ½ diameter Heliac foam cables on two sides of tower shall sustain the maximum stresses imposed by the following ambient conditions without permanent deformation damage or degradation to operations.

Temperature -30°F to 110°F

Tower Design Criteria **TIA Standard RS-222-G**
140 mph Basic wind speed (with 0" of radial ice)
60 mph wind speed (with 1.25" of radial ice)
Class – III
Exposure - C
Topographic Category – 1
Location – Suffolk County – Boston, MA

Relative humidity 5% to 100%, including condensation

Environment Salt spray
Urban industrial fumes
Wind borne sand and dust

Live Loads Platform
300 lb concentrated live load over any one sq ft of area

FAA Equipment Wind Eight communications antennas (V/V configurations) each:

Loads

projected area = 2.34 sq ft each antenna x 8 = 18.72 sq ft total

Height = 12ft-9" (153")

Weight = 17lbs each

Junction boxes:

Two 30" x 30" boxes, one on each side of tower mounted to railings = 6.25 sq. ft. each box = 12.5 sq ft total area

Weight of j-boxes and hardware = 60lbs each (120lbs total)

One – 6ft long $\frac{3}{4}$ " diameter lightning rod and down conductor mounted on a minimum of 2 inch IPS Rigid steel pipe **extending 26 ft total above the platform floor.**

FAA Equipment Dead Loads

Add for 0.5 inch of radial ice on all equipment

Six communications antennas: 17lb x 8 = 136 lbs

Junction Boxes – (60lbs ea) (2) = 120 lbs

2 $\frac{1}{2}$ " IPS Antenna pipe mounts, 4ft high x 8 = as designed by tower manufacturer

20ft of 2" rigid pipe for lightning protection as designed by tower manufacturer

2.1.5 Design requirements

2.1.5.1 Work Required

The contractor shall submit structural design calculations and design fabrication, foundation and erection drawings. All design calculations shall be indexed and arranged in an orderly manner with appropriate sketches so that any element may be easily identified. Complete structural calculations are required covering all parts of the structures and all related items. Tower twist, sway and displacement shall be determined by analytical methods. All design loads shall be identified; design methods and assumptions indicated. When computer printouts form a portion of the design calculations, the contractor shall include all input diagrams and information needed to relate the printout to the design elements. The computer programs utilized shall be identified and a brief description of each shall be included. **The final design submittal shall be certified by a Registered Professional Engineer (and the foundation design shall be stamped by PE within the state where the site is located).**

2.1.5.1 Tower Drawings

The drawings shall include plan and elevation views, antenna mounts, grounding system and any pertinent notes. Erection drawings shall indicate member location, bolt sizes and number ladder attachment with safety climbing device, antenna mounts and all other information to clearly depict required elements for field erection a parts list showing the member size and length shall be provided in the erection drawings shall be provided for the installation of the obstruction light system. Supply FAA with complete tower drawings package also in AutoCAD or Microstation format.

2.1.5.1 Foundations Drawings

The foundation drawings shall include both plan and elevation views. Drawings shall include reinforcing bar size, quantity, anchor bolt size and position and other pertinent information for constructing the foundations. Supply FAA with complete tower drawings package also in AutoCAD or Microstation format.

2.2 MATERIALS

2.2.1 General

Unless otherwise indicated materials shall conform to the specifications and other requirements below. Where no specification is indicated the materials shall be of a good commercial quality suitable for the governments intended use and shall be subject the approval of the COTR. The contractor shall furnish all materials and items as required to complete the structure.

2.2.2 Tower Legs

The tower legs shall be fabricated of steel pipe, structural angles or plates. Steel pipe shall have a minimum yield strength of 33,000 lbs per square inch per ASTM A-53 or ASTM A-501. Structural angles or plates shall have a minimum yield strength of 36,000 lbs per square inch per ASTM A-36. Legs fabricated from steel having a minimum yield strength of 50,000 shall conform to ASTM A-618 grade 3 for pipe and ASTM A-242 for angles or plates

2.2.3 Tower braces

The tower braces shall be have a minimum yield strength of 33,000 lbs per square inch per ASTM A-53 or ASTM A-501. Structural angles or plates shall have a minimum yield strength of 36,000 lbs per square inch per ASTM A-36.

2.2.4 Base Section

The base section of all self supporting towers shall be fixed base utilizing load bearing plates drilled to receive anchor bolts cast into the foundation or it may be a short section or integral part of the first tower increment. If a separate base section is used it shall be cast into the foundation and similar in construction to the other tower increments. Base sections of guyed towers may be fixed base as above or hinged base with a load bearing assembly cast into the foundation or attached with anchor bolts cast into the foundation. Anchor bolts shall be furnished with the tower.

2.2.5 Bolts, Nuts and Washers

Bolts, Nuts and Washers, High Strength - Shall conform to ASTM A-325 or A-490.

Bolts, Nuts and Washers, Other Than High Strength - Shall conform to ASTM A-307 Grade A

Plain Washers Other Than Those in Contact With High Strength Bolt Heads and Nuts - Shall conform to ANSI B-18.22.1 Plain Washers Type B

Locknuts.- A jam nut shall be used on each bolt beneath the full nut . Self locking nuts intended for use on exterior bolted connections with any associated lock washers may be substituted for approval as a substitute for the regular nut and jam nut.

2.2.6 Grating

Expanded Metal Type: Military Specification MIL-M-17194

Bar Type: Federal Specification RR-G-661

2.3 SAFETY CLIMBING DEVICES

A walk-up stairway (OSHA approved 1910.24) shall be provided under this contract. The stairway shall be structurally designed to meet all applicable Federal, State and local Safety and Building codes for the location of the site.

Platform Guardrails shall have a height of at least 42 inches and the mid-rail at 21 inches. Provide at least a 4" toe board around the platform

2.4 FABRICATION

2.4.1 General

Fabrication shall be in accordance with the AISC specification. Members shall not have sharp edges which would be hazardous during handling or other irregularities that would interfere with erection. Welding shall conform to the AWS structural welding code.

2.4.2 Stamping

Each separate member except bolts, washers, etc shall be clearly marked by stamping into the steel the part number shown on the drawings. All parts shall be marked in the same relative position. The mark shall be stamped in the steel before galvanizing and shall be clearly visible in the erected structure. Each piece shall be marked with one inch high letter/number combination.

2.5 FINISHES

Galvanizing – All ferrous parts shall be hot dipped galvanized after fabrication in conformance with ASTM A-123 and A-385. Hardware nuts bolts washers and other minor items shall be galvanized by the hot dip method in conformance with ASTM A-153. The projection portions of anchor bolts plus 12 inches shall be galvanized. The interior of all pipe shall be galvanized.

PART 3 EXECUTION

3.1 PREPARATION FOR DELIVERY

The complete tower system will be packed to insure carrier acceptance and safe delivery at the destination in containers complying with rules and regulations applicable to the mode of transportation.

3.2 FIELD QUALITY CONTROL

Quality control shall be in accordance with the American Institute of Steel Construction Specification. All tests and inspections to determine compliance shall be made by the contractor and shall be subject to Government observation or verification. Contractor shall notify the CO ten (10) days in advance of the delivery to allow a government representative to inspect the towers upon delivery.

3.3 Tower Kit Shall Include:

- Complete tower steel and hardware
- Anchor bolts and templates
- OSHA approved walk-up stairway
- Custom top platform with handrails (OSHA approved)
- Eight (8) custom perimeter platform antenna mounts
- One custom designed structural center support pole (2 inch) with EIA 3/4" lightning arrestor rod (6ft long) that extends a total of 26ft to the tip above the platform level
- Class two II Thompson 28 Lightning platform perimeter ring with down conductors (two locations)

- Obstruction Light kit (two locations)
- Installation/erection Drawings (both hard copies and AutoCAD or Microstation)

3.4 Delivery and

Fabrication shall be accomplished per the Government approved 100% Design Drawings established by the Contractor. Acceptance of the antenna tower assemblies will be accomplished under the direction of the Contracting Officer's Technical Representative (COTR) upon satisfactory delivery of the towers to the job site. All trucking charges, permits, and unloading / crane costs, etc. associated with the complete tower delivery to the job site are to be paid by the contractor/tower manufacturer. All tests and inspections to determine compliance with the specifications of the contract requirements shall be made by the contractor and are subject to government inspection.

Schedule of Deliverables

- Design Calculations (2 hard copy, 1 electronic copy)
- Fabrication Drawings(2 hard copy, 1 electronic copy)
- Erection Drawings with schedule of materials(2 hard copies, 1 electronic copy)
- Foundation Design and Drawings(2 hard copy, 1 electronic copy)
- Antenna Mount Assembly Drawing(2 hard copy, 1 electronic copy)
- Grounding System Drawing(2 hard copy, 1 electronic copy)
- Antenna Platform Drawings(2 hard copy, 1 electronic copy)
- Stairway Safety System Installation Drawings(2 hard copy,1 electronic copy)
- Finished Towers-Delivered and Offloaded, Boston Logan Airport, 1- 10' RTR Antenna Tower.
- The tower will be complete in parts and inventory packaged to be satisfactorily and efficiently inspected by the COTR accepting delivery. The tower assembly will include all components required for tower erection, antenna mounting, site grounding, obstruction lighting, and ladder safety systems (or walk up stairway) as called out in the design documents and specifications. Contact FAA Field coordinator/ Contracting Officer a minimum of ten (10) days prior to delivery for schedule, and again within 48 hours upon final delivery.

REPLACEMENT OF DAMAGED OR MISSING PARTS.

Any damaged or missing parts noted at the time of the delivery inspection shall be replaced at no cost to the government. Parts damaged after the acceptance of the shipment shall, when requested, be replaced by the fabricator at a reasonable cost and time schedule.

Tower Height

The height of the tower referred in the bidding documents shall be the height of the walking platform of the tower, above the top of the concrete footing.

Appendix “C” – MassPort Contractor Requirements